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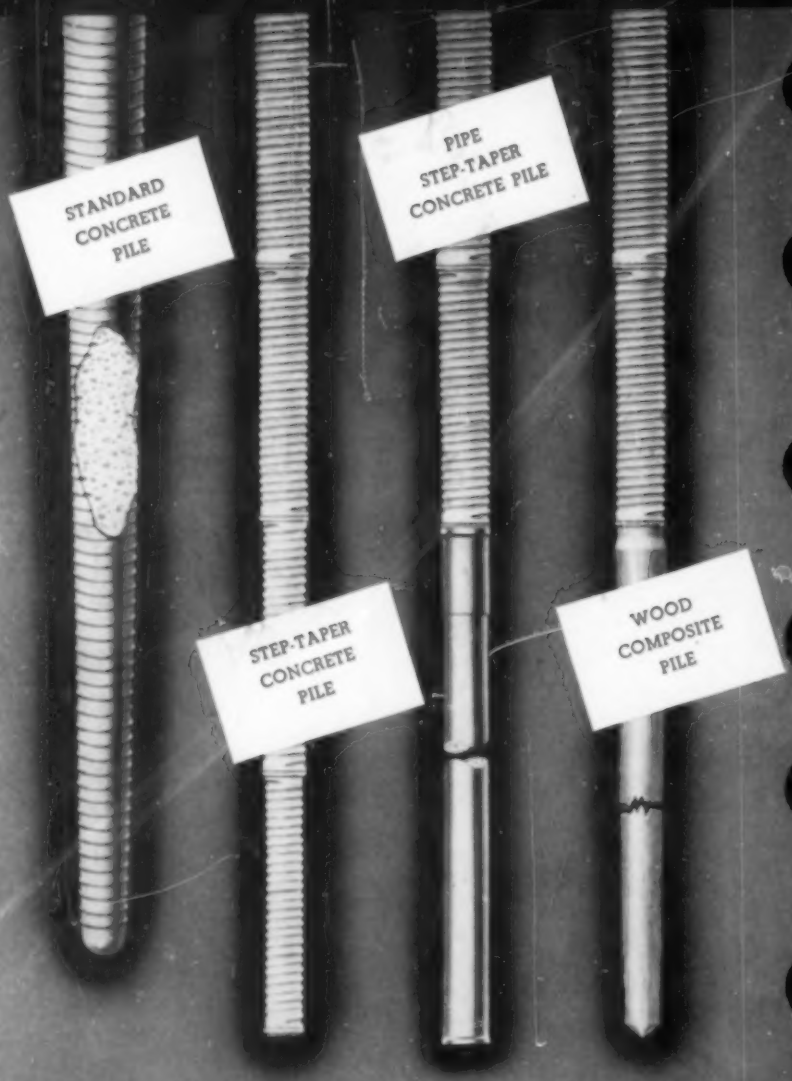

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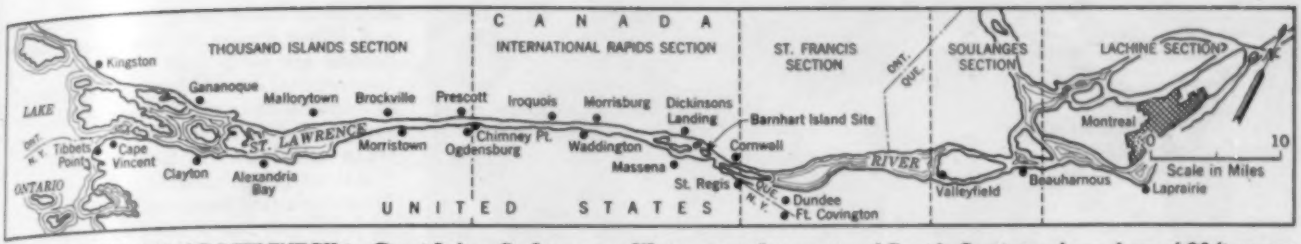


FIG. 1. NAVIGATION BOTTLENECK in Great Lakes–St. Lawrence Waterway is International Rapids Section, where drop of 92 ft occurs in 48-mile distance between Ogdensburg and St. Regis, N.Y. Average mean monthly flow of St. Lawrence River is 237,000 cfs. The 36 turbines projected for the International Powerhouse have rated capacity of 2,200,000 hp, at best gate under 81-ft head, and generators have total capacity of 1,881,000 kw.

St. Lawrence Seaway Promises

Cheap Power Plus Large Navigation and Defense Benefits

FRANK P. FIFER, M. ASCE

Engineer Consultant, North Atlantic Division, Corps of Engineers, U.S. Army, New York, N.Y.

ATTENTION continues to be focused on the projected St. Lawrence Seaway because of navigation, power, and national defense values. Navigation benefits include provision for an estimated water traffic of up to 84 million tons. The potential power development would yield over a million horsepower on the United States side alone, which, it is estimated, could be delivered to points in New York State at about half the present cost of fuel-electric energy. Such power can be transmitted as far as New York City without difficulty. The cost to complete a 27-ft Seaway is estimated at about 800 million dollars for the whole length from Duluth to Montreal and 600 million for the International Rapids Section, in which the chief works are located, including the power development. This section forms the main subject of Mr. Fifer's article, based on the paper he presented before the Waterways Division of the ASCE Washington, D.C., Fall Meeting.

FOR GENERATIONS the Great Lakes–St. Lawrence "Seaway" has been under construction, since Champlain in 1608 explored the system as far as Lake Huron. With the common purpose of opening up a vast land-locked interior, the people of the United States and Canada have been continuously engaged in building modern works to improve the connecting channels and canals of the Great Lakes and their outlet to the sea through the mighty St. Lawrence. Step by step the relatively few barriers along this great natural highway for commerce have been overcome, until deep-draft navigation from Duluth to the Atlantic Ocean is now in sight.

There is deep-draft navigation (32.5 ft) from the Atlantic to Montreal, one of the world's great seaports although located about 1,000 miles from the ocean. There is also deep-water navigation (generally 25 ft) from Duluth to Ogdensburg, N.Y., a distance of about 1,250 miles. To complete the seaway there only remains the work of canalizing the 120-mile stretch between Ogdensburg and Montreal for a 27-ft depth and deepening the channels between the lakes from their present depth (21–25 ft) to the 27-ft depth specified in the 1941 International Agreement. A 14-ft canal on the Canadian side at present provides navigation between Ogdensburg and Montreal. In the Thousand Islands Section, above Ogdensburg, the 27-ft project depth is practically completed for a width of 450 ft.

This article is chiefly concerned with the International Rapids Section, consisting of 48 miles from Ogdensburg downstream to St. Regis, N. Y., with a drop of 92 ft (Fig. 1).

1941 Report and International Agreement

Beginning in 1897 with the report of the U.S. Deep Waterways Commission, many reports on the St. Lawrence Seaway project in one form or another have been presented. The project as at present constituted dates from January 3, 1941, when a Board of Engineers appointed by the United States and Canadian Governments presented a plan known as the "238–242 Controlled Single-Stage Project" to a Committee made up of the Canadian Temporary Great Lakes–St. Lawrence Basin Committee and the U.S. St. Lawrence Advisory Committee. Following the submission of this report, the diplomatic branches of the two countries signed the International Agreement of March 19, 1941, providing for the construction of dams and power works in the International Rapids Section and for completion of a waterway of 27-ft depth from Duluth to the sea. In accordance with this agreement and based on the "238–242 Controlled Single-Stage Project," the Corps of Engineers, St. Lawrence River District, issued its 1942 Report, consisting of 39 volumes containing plans and specifications for the navigation-power development in the International Rapids Section.

The International Agreement of 1941 provided for the development of the International Rapids Section by construction of a control dam at Iroquois Point, a dam in the Long Sault Rapids at the head of Barnhart Island, a powerhouse at the foot of Barnhart Island, straddling the International Boundary, a side canal with one lock to carry navigation around the control dam, a side canal with two locks and a guard gate to carry navigation around the Long Sault Dam and Barnhart Island powerhouse, all these canals and locks to be on the United States side. On the Canadian side the Agreement includes a lock near the powerhouse abutment for continuance of 14-ft navigation and the necessary dikes, channel enlargements and relocations.

Construction of Long Sault Dam and its coordination with other features of the project are the most dif-

MAJOR WORKS for St. Lawrence Seaway and Power Project in International Rapids Section are Long Sault Dam (center) and International Powerhouse (right foreground), at opposite ends of Barnhart Island. Also shown on view of project as it will appear when completed are locks on Long Sault Canal on left (United States side): Grass River Lock (left foreground), Robinson Bay Lock (directly left of Long Sault Dam), and Guard Gate (above). Cornwall Canal relocation and lock on Canadian side appear just to right of International Powerhouse.

ficult and interesting problems of the entire Seaway. The chief features which must be coordinated with the dam are the new Cornwall Canal lock, the international Powerhouse, and the Massena (ALCOA) Power Canal intake works. (See Fig. 2.) Before the power pool is raised the Long Sault Guard Gate and all contiguous dikes must also be completed.

Long Sault Dam as designed is a concrete gravity structure with a maximum height of about 145 ft. It connects the New York shore with the head of Barnhart Island, and together with the International Powerhouse, which connects the other end of the island with the Canadian shore, dams the whole flow of the river to form the power and navigation pool. The dam consists of an overflow spillway flanked on each side by concrete bulkheads or non-overflow sections. Forty spillway openings, with vertical-lift roller-type crest gates, 40 ft wide by 25 ft high, will bypass water not used in the powerhouse.

Twenty-two of the 40 gates will be operated by two traveling gantry cranes. For winter operation, 18 of the gates will be split horizontally at various elevations into two sections for the purpose of skimming ice. These split gates will be operated by individual motors and will be heated along sides and sills. In addition, an air bubbler system will prevent the formation of an ice sheet adjacent to the gates. The spillway apron and bucket are an integral part of the structure. Depth of tailwater renders a stilling basin unnecessary.

Proposed Construction Steps

For construction of the Long Sault Dam, it is proposed first to divert the entire flow of the river through the North Channel while construction is carried on in the closed South Channel and then to divert the flow through the South Channel, closing off the North Channel. This procedure will require two diversion cuts through Long Sault Island. Construction stages and closure operations will depend on the progress of work on the Barnhart Island powerhouse, which because of its magnitude governs the construction program of the whole project.

Construction of Long Sault Dam is planned for three stages: (1) Building of the south portion with piers and sills, leaving thirteen 40-ft openings between piers, except for the sills; (2) building the north portion to full height except for five additional openings, making a total of 18 clear openings 40 ft in width with concrete sills over which the entire flow of the river will pass; and (3) closing these 18 openings and raising the pool. To divert the main body of the river from the north channel across the main cut in Long Sault Island, in the second stage, it will be necessary to construct a cofferdam of the rock-fill timber-crib type in water flowing at high velocity. There will be a clear opening between cribs of about 20 ft. After all the cribs are in place the openings will be closed with concrete stop-logs.

The Barnhart Island powerhouse is often referred to as the International Powerhouse. As designed, the combined powerhouse is about 180 ft wide and 3,600 ft long, half on each side of the international boundary line. This will be the largest powerhouse in the world, with a total proposed capacity of 2,200,000 hp. Each of the two sections will contain 18 main units, one house unit and one ice sluice at midstream and two ice sluices at the abutment. The main units are of the vertical-shaft Francis type rated at 61,100 hp at best gate under an effective head of 81 ft to the 238 pool level. Scroll cases are of concrete, unlined, and draft tubes of simple elbow type provided with stoplogs. Powerhouse units will have a capacity of 9,000 hp each at full gate opening.

Each powerhouse will have 18 generators rated at 55,000 kva, giving a total installed capacity of 940,500 kw. The generator room of each powerhouse will be equipped with two 300-ton traveling cranes. The transformers will be located on the downstream side of the powerhouse. Power from six of the units will be stepped up to 115,000 v and that from the remaining 12 units to 230,000 v. It is planned to transmit some of this high-voltage current to the New York metropolitan area.

During the war (1942) a part of the transmission line was built from Massena to Taylorville, N.Y., a distance of 78 miles. This line was originally designed for steel towers but, because of lack of steel and delivery delays, was changed to wood-pole construction. This experiment in building a 230,000-v transmission line on wood poles has proved structurally satisfactory. It was in use during the war to transmit power to the Government aluminum plant at Massena.

A severe sleet storm which occurred in the first winter of its operation (1942–1943) put all the other transmission lines in the area out of order, including three steel-tower lines, leaving only the wood-pole line in operation, and thereby saving the two aluminum plants at Massena from a major shutdown. The line has not been tested under full voltage as the power transmitted to Massena was at 115,000 v. Surveys for the extension of this line to New York City have been completed and plans and specifications are ready for its construction.

Control Dam, Locks and Other Features of Project

The control dam at Iroquois Point, called the Iroquois Dam (Fig. 3), is planned as a gravity concrete structure with a maximum height of 118 ft, with concrete sills and piers founded on ledge

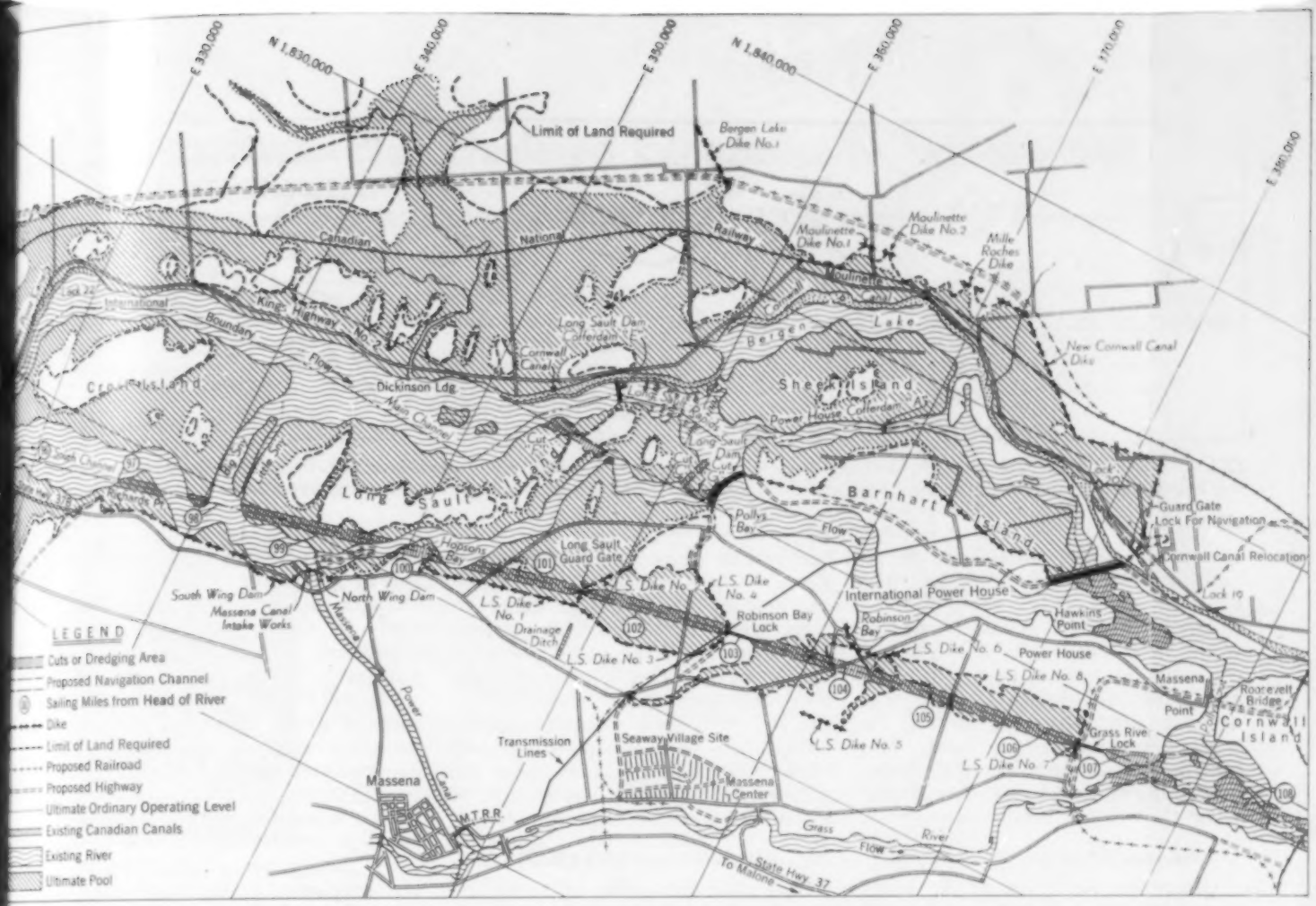


FIG. 2. KEY SECTION of St. Lawrence has complicated pattern of islands and channels in existing river. Ultimate pool for Seaway Project is also indicated. International Boundary runs through exact middle of International Powerhouse at foot of Barnhart Island, then through North Channel and Long Sault Rapids. Long Sault Dam at head of Barnhart Island and locks in Long Sault Canal are entirely on United States side.

rock, constructed within cofferdams. Openings between piers are to be controlled with 40 vertical-lift gates 50 ft wide. The deck will carry the tracks for two gantry cranes and a concrete highway with provision for a future railroad track. The Rockway Point Lock and Canal are necessary to carry deep-draft navigation around the control dam.

Channel enlargement from Galop Island to Morrisburg, a distance of about 14 miles, which includes the Ogden Island section, is necessary to satisfy the requirements for winter operation of the International Powerhouse and to provide suitable navigation depths. Channel enlargements are designed to provide mean velocities of 2.25 ft per sec to insure formation of winter ice cover, thus preventing the formation of frazil ice.

The Massena Canal now carries a flow of 25,000 cfs to the ALCOA powerhouse near Massena, N.Y., where, with a 43-ft head, 80,000 hp is developed. To maintain this flow during the project construction period, an open concrete structure is planned for construction alongside the present entrance to the canal, with eight sills 25 ft long and 10-ft piers supporting a crane deck so that stoplogs can be added as the pool rises. When this structure is completed, the present canal entrance will be blocked by a double cofferdam enclosure and a permanent earth dam built therein.

The Long Sault Ship Canal, on the American mainland, will pass traffic around the Long Sault Dam and International Powerhouse. Principal structures in the canal will be the guard gate and two locks, Robinson Bay and Grass River. The purpose of the guard gate is to prevent the flow of water from the upper pool in the event of an accident to any of the structures, gates, or dikes in the vicinity of Robinson Bay Lock. (See Fig. 2.) The guard gate design consists of two concrete walls 110 ft apart on which two sector-type gates are mounted. This type of gate was chosen because it can be closed against flowing water and its operation does not need to be interlocked with that of the upper miter gate of the Robinson Bay Lock. The sector gate can remain open for the passage of traffic without delay while with the miter type, either the guard gates or the upper lock gates would have to be closed at all times.

Robinson Bay Lock, the upper of the two locks required for the Long Sault Canal, is the same size as the Welland Canal Locks, the lift ranging from 38 to 42 ft, and the gates are of the miter type. The Grass River Lock, at the lower entrance to the Long Sault Canal, is similar in design to the Robinson Bay Lock. Both locks will have bobtailed swing bridges across the upper gate section for highway and rail traffic. Most of the machinery and other features of the three locks and the guard gate have been standardized so that all parts will be interchangeable.

Seven Years Allowed for Completion

One year will be needed for preliminary work and four years for the principal structures. It is planned to complete the project within five years to the extent of raising the pool, providing 27-ft navigation, and completing three units in each powerhouse. Remaining work, including installation of 15 additional units in each powerhouse and dredging opera-

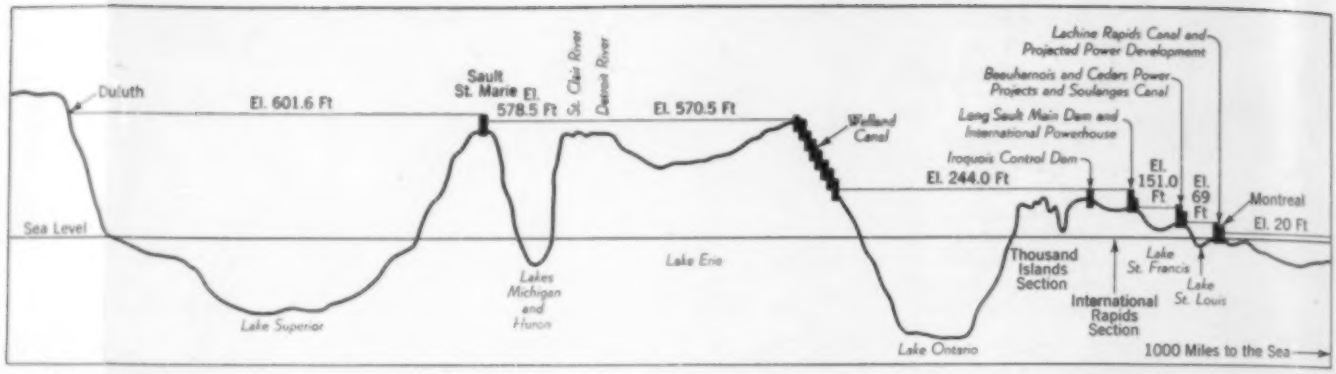


FIG. 3. WATER-LEVEL PROFILE of St. Lawrence Seaway and Power Project, without scale, gives elevations in various sections of great waterway between Duluth and Montreal, total distance of 1,370 miles. Project depth for navigation for entire distance is 27 ft.

tions, will require about two years, making a total of seven years for the whole project. This is a well-planned progress schedule. A faster schedule would be too expensive and a longer construction period would also increase the cost because of the loss of revenue and increased interest, insurance, rentals, and overhead. This schedule contemplates some winter concreting on the principal structures when the weather is not too severe.

Excavation in Millions of Cubic Yards

Quantities for a few of the major items in the International Rapids Section only are as follows:

Dry excavation:	
Earth	73,000,000 cu yd
Rock	3,500,000 cu yd
	76,500,000 cu yd
Wet excavation (dredging):	
Earth	23,000,000 cu yd
Rock	500,000 cu yd
	23,500,000 cu yd
Total	100,000,000 cu yd

Concrete yardages are as follows:

International Powerhouse	2,000,000
Long Sault Dam	600,000
Each navigation lock	300,000 to 500,000
Iroquois Control Dam	240,000
Miscellaneous	200,000
Total	4,500,000

All features of the work have been divided into four priority groups: (1) Items which are necessary before construction of the project itself can be started, such as Seaway Village to house federal personnel, access highways and railroads, bridges for access routes, access to powerhouses which must cross the 14-ft canal, and a new substation with transformers and distribution lines to all sites. (2) Features of the project which must be started as soon as possible after authorization, either because early completion is necessary or because of a long construction period, such as channel dredging, channel and canal excavation, dams, locks and powerhouse. (3) Permanent work which can be deferred until other items are in progress, but which must be completed before the pool is raised such as certain dikes, railroad and highway relocation and rehabilitation. (4) Deferred items which can be accomplished after the pool is raised such as dredging of shoals below the powerhouse and the installation of additional units in the powerhouse.

Cost Estimated at $800,000,000

The estimated cost, as submitted by the Chief of Engineers, U. S. Army, to Senator Wiley for the Subcommittee of the Senate Foreign Relations Committee, based on July 1948 cost levels, to complete the combined seaway and power project from Duluth to Montreal is $802,566,000. The estimated cost of the International Rapids Section, included in the previous sum, is $588,613,000.

The estimated cost of "Power Priority Project," as developed by the Power Authority of the State of New York and the Hydro Commission of Ontario, based on July 1948 price levels, is $463,374,000. One-half of this total cost for a power-only development would be assumed by the Power Authority of the State of New York. This does not include a switchyard which must be built near the powerhouse at an estimated cost of $7,300,000.

Based on an average yearly energy production of 6.3 billion kwhr, the cost of power at the site, with state financing, will be 2.31 mills per kwhr, which, added to transmission charges of 1.33 mills per kwhr, gives an estimated cost of power delivered to load centers in New York State of 3.1 to 3.6 mills per kwhr, about half the present cost of fuel-electric power. In the combined navigation and power project, the cost of the hydro power would be less, as part of the common works in this case are chargeable to navigation.

As for navigation benefits, a 1948 study by the U. S. Department of Commerce contains the following passage:

"It will be noted that the total estimated traffic through the Seaway, including both general cargo and bulk commodities, ranges from 57,000,000 to 84,000,000 tons. This traffic estimate greatly exceeds the estimates made in studies issued prior to the war. The major reason of course is the anticipated traffic in iron ore and petroleum which received no serious consideration in studies of the Seaway prior to the one issued by this Division last year."

Recent developments on the St. Lawrence Seaway Project may be briefly summarized, as follows. On July 16, 1948, the Power Authority of New York State and the Hydro Commission of Ontario submitted simultaneous applications to the International Joint Commission for a permit to construct the power priority project. At the same time the Power Authority of New York State applied to the Federal Power Commission for a license to develop the project. Hearings were held before the Federal Power Commission in Washington on October 4–7, 1948, but no further action has been taken on the pending applications.

President Truman, in his budget message to Congress, submitted in January 1949, included an appropriation item of $20,000,000 for the initiation of the Seaway and Power Project but to date no Congressional action has been taken.

An Administration bill, S.J.Res. 99, which would authorize the full project Duluth to Montreal, and approve the 1941 Agreement, was introduced in Congress on June 1, 1949. It includes provision for tolls on shipping. Congressional hearings thereon are indicated for early in 1950.

Columbia Basin Plan Declared Economically Feasible and Acceptable to States Concerned

HE FINAL PLAN of the Corps of gineers for the comprehensive de- pment of the Columbia River is r in a form which is acceptable to the states involved and which is nomically feasible according to tionally used standards, members the Waterways Division were told the session held in connection

pt. William O. Hiltabidle, Jr., Member, ecutive Committee, Waterways Division; ief Inspector, Bureau of Yards and Docks, S. Navy, Washington, D.C.

ith ASCE's Washington, D.C., Fall eeting. These statements were ade by Col. William Whipple, Jr., ASCE, District Engineer, Walla alla, Wash., District, Corps of ngineers, in his paper entitled Plans for Comprehensive River evelopment," abstracted below.

Two other main papers were de- ered at this session, which was esided over by Commodore Wil- am O. Hiltabidle, Jr., M. ASCE, a ember of the Waterways Division xecutive Committee, and Chief In- ector, Bureau of Yards and Docks, S. Navy, Washington, D.C.

Subsidence of the Navy's Long each, Calif., Shipyard has reached rate of nearly 2 ft a year, or a total date of more than 9 ft, endanger- g valuable installations at high le, Commander Lewis C. Coxe, EC, U.S. Navy, Public Works fficer of the Shipyard, stated in his aper. To prevent invasion by the a, remedial construction estimated cost $1,500,000 the first year will on be started, Commander Coxe id. The nature of this construc- n and methods proposed to stop bsidence and consequent inunda- on of this area, are detailed in an rticle based on his paper and printed sewhere in this issue.

The St. Lawrence Seaway Project holds promise of large benefits from the points of view of navigation, power and defense, according to copious information contained in the third paper presented at this session, that by Frank P. Fifer, M. ASCE, Engineer Consultant, North Atlantic Division, Corps of Engineers, U.S. Army. His paper, printed elsewhere in this issue in shortened form, includes a bird's-eye view of the mammoth structures designed by the Corps of Engineers for the International Rapids Section of the St. Lawrence River.

William Whipple, Jr.

Speaking of plans for comprehensive river basin development, Colonel Whipple said that the term "comprehensive" has been commonly misinterpreted. He was using the term, he said, to mean planning which has as its main objective the development of water resources, although it also considers all necessary economic and social relationships.

"Collateral effects and benefits in fields such as agricultural development, recreation, general industry and trade, railroads and highway traffic, labor standards and general standards of living are considered," he declared, "where applicable or necessary, but are not direct objectives of comprehensive water resource planning in this sense."

"The main concept or structure of a basin plan for optimum results cannot be predetermined from general principles," Colonel Whipple said, "but is empirically derived from engineering relationships and physical conditions. Generally speaking, federal law and policy prescribe that flood control and navigation developments may be undertaken only when the economic benefits, to whomsoever they may accrue, exceed the economic costs.

"Flood control benefits can be quite definitely evaluated, although indirect benefits and preservation of health and human life introduce qualitative factors. Navigation benefits are in some ways more difficult to evaluate with precision but qualitative methods are possible. In the case of irrigation, the U.S. Bureau of Reclamation has been reviewing procedures to determine benefits. Repayment requirements may control the feasibility of irrigation projects, according to the formulas of reclamation law.

"In the case of hydroelectric power, laws and precedents vary. For the Columbia Basin, it is assumed conservatively that repayment is required of all operation and maintenance, interest and amortization of power investment, including transmission. To determine the benefit cost ratio, the economic value of power was determined by a joint study by the Federal Power Commission, the Bonneville Power Administration and the Army Engineers."

Special difficulties arise, Colonel Whipple said, when objectives are broadened and additional features are brought into the system, such as benefits from recreation, fish and wildlife, elimination of stream pollution, preservation of forest cover, soil conservation, health, and general economic and social welfare.

Colonel Whipple stressed the critical importance of flood control and power development. The latter alone, he said, would be economically feasible but more expensive than when provided by a multiple-purpose development. However, flood control and navigation are not feasible except in multiple-purpose developments. Ordinarily flood control and power require separate storage. In the Columbia Basin, runoff prediction is the key to joint utilization of storage reservoirs. The speaker then discussed the basic principles of operating main reservoirs, which, he said, can be operated for optimum firm power production most of the year.

In concluding, Colonel Whipple said that the magnitude of the potentialities of the Columbia River resulted in unusually complex, intensive and prolonged planning effort. Many delays were caused by the necessity of obtaining cooperation from various interested agencies or developing alternates to projects objected to by certain localities. But the final plan is now acceptable to all states and provides a program for well into the future. This plan, he believes, demonstrates economic feasibility according to nationally used standards, and its adoption will add to national as well as regional welfare.

Mexico Pushes Her Highway Construction Program

STARTED a bare quarter century ago, the national highway system of Mexico has grown rapidly since the advent of the automobile and truck so that today the system consists of four thousand miles of asphalt surfaced highways connecting coast with coast and border with border. The federal-aid state system, including half again as much asphalt mileage, traverses every state, and 600 miles of graveled rural roads now connect formerly isolated yet productive areas with markets. President Alemán's Secretary of Communication and Public Works, Señor Augustin Lopez, directs the National Highway Board's work of building and maintaining the national system and supervising the federally aided state roads. Reporting also to Secretary Lopez' Ministry is the Department of Secondary Roads.

This symposium, based on papers presented by the authors at the Society's meeting in Mexico City, relates the amazing economic lift the highways have given to our south-of-the-border neighbor and records how the system is being financed, designed, constructed and extended to every corner of Mexico.

Highway Program Makes Important Economic Contribution

ROMULO O'FARRILL, SR.
President, Asociacion Mexicana de Caminos, Mexico

BASIC RESOURCE for the construction of highways in Mexico is the tax on gasoline. This tax was imposed in 1925 and allocated to the National Highway Commission, created in the same year, to initiate a program of highway construction in a country which was at that time virtually without a highway network. At that time Mexico had 16 million inhabitants and some 10,500 miles of railways.

To start the newborn highway program, a modest budget of a little more than $600,000 was made available. Besides it was necessary to overcome the serious obstacles created by the country's rough and extended terrain of nearly 764,000 sq miles, the lack of modern machinery and the necessity of preparing technicians for the great new task. In this same year, 1925, the first plant for the assembly of automobiles was built in Mexico.

Today Mexico has over 13,500 miles of paved or surfaced highways, and many thousands of miles of secondary roads. In 1948 the returns from the tax on gasoline amounted to $15 million. The national budget for the construction and maintenance of highways, largely exceeding the gasoline tax, is nearly $35 million. Foreign tourists provide Mexico with a yearly income of over $90 million while the home tourist trade has been estimated at nearly $6 million annually.

There are nine automobile assembly plants in Mexico and four large tire factories; premiums on motor insurance (a business unknown in Mexico in 1925), in 1948 totaled nearly $3,500,000. Sales of gasoline have increased tenfold. The registration of motor vehicles has risen from 40,000 to 250,000 units. Excluding the petroleum industry, and considering only such businesses as are closely connected with automobiles and the tourist trade, 250,000 new jobs have been created largely as a result of the new highways.

Romulo O'Farrill, Sr., President, Asociacion Mexicana de Caminos, Mexico

System of National Highways

From 1926 to 1932 Mexico's highway program was keyed only to the opening of main roads, so that the new highways would complement the railway net and create a mixed system of communications as early as possible. Thus, the national highways from Mexico City to Acapulco, to Vera Cruz and to Nuevo Laredo, were finished or considerably advanced, and the highways from Mexico City to Guadalajara, and from Matamoros to Mazatlán were begun.

In 1932, a new financial policy for highways was introduced. A law was passed authorizing the federal government to contribute 50 percent to the costs of state roads to be included in the national highway system, and also giving the states participation in the revenues from the gasoline tax, which was raised from about 1 cent to $4^1/_2$ cents. This new arrangement facilitated the progress of construction, since a substantial part of the federal budget for highways was duplicated by the states.

By 1933 Mexico had a network of 700 miles of highways. The registration of motor vehicles had risen to 66,000 of which 6,600 were buses and 24,500 cargo trucks. The tax on gasoline yielded $2^1/_4$ million. In 1938 the country had 4,600 miles of highways, the consumption of fuel for automobiles rose to 140 million gal, and the tax on gasoline yielded nearly $5 million.

The last momentous change in the structure of the Mexican highway program took place in 1948, with the initiation of a program for the construction of secondary roads. Such roads also are now constructed with federal aid, limited in this case to 33 percent of the cost, leaving to local authorities and individuals the remainder. This new development of the highway program is important since it not only satisfies the necessity

of access to important agricultural, mining and industrial centers, but also develops feeders to the main highways. Furthermore, the greater part of the feeder roads will be constructed within the next ten to twenty years and will form part of the highway system of each state as roads of primary or secondary importance.

Balanced Program Under Way

Thus after 24 years, Mexico has a balanced program of highways. Without neglecting the great longitudinal and transverse routes and the local systems of each state, 600 miles of rural roads of pressing local importance are to be constructed to integrate a highway system in which each type of road carries out its own transportation functions.

Funds invested in highways have considerably augmented the income of the government. Roads have stimulated large investments from private sources; they have created remunerative occupation for a considerable percentage of the population, and have stimulated agriculture, business and mining. It would be difficult to find in the economic history of Mexico a program of public works bringing greater benefits to the majority of the people. The Mexican highway program is possibly the most intense being developed anywhere in the world, if national economic resources are taken into account.

ZACATECAS-MOYAHUA HIGHWAY crosses Juchipila Bridge near Jalpa, Mexico.

Including both main and secondary roads, Mexico now constructs some 2,500 miles annually, an amount which probably will be surpassed in 1950. At this rate, Mexico could duplicate its exist ng mileage every five years, an accomplishment which would place it in the next decades among the countries best served by communication systems on this Continent.

Coast-to-Coast and Border-to-Border Routes Make Rapid Progress

ARMANDO SALINAS

Director General of Highways, Ministry of Communications and Public Works, Mexico

MEXICO is a ruggedly mountainous country and therefore most of its highways are built at high cost, yet the Government must limit its construction program to its income. During the incumbency of President Miguel Alemán, preference has been given to the completion of some of the highways begun under former presidents.

Among the highway routes on which construction is being pushed (Fig. 1) are those from Mexico City to Ciudad Juárez and from Nogales to Guadalajara, routes which, when completed, will join the capital with points on the border of the United States. Progress is also being made on the Cristobal Colón Highway which will be completed in the near future, and which will connect Mexico with the Guatemalian border thus fulfilling Mexico's international obligation for the construction of the Pan American Highway.

Besides the north-to-south routes, work is progressing on other highways which will connect the Gulf of Mexico with the Pacific Ocean. The Matamoros-Mazatlán Highway is completed except for the stretch from Durango to Mazatlán, now under construction. Construction on these routes is expected to be completed in 1952. Construction is also progressing on the Coatzacoalcos-Salina Cruz Highway which, taking into consideration its geographical location, has been designed with a wider roadbed than the rest of the highways to accommodate expected freight traffic.

Armando Salinas, Director General of Highways, Mexico City, Mexico

Roads for Lower California

The present government has special interest in the construction of the highways essential to the life and economical development of the peninsula of Lower California, where the Tijuana-Mexicali, Mexicali–San Felipe and Tijuana–San Quintín highways are now under construction together with another to connect the peninsula with the rest of the Republic via the State of Sonora.

Some important construction is also being done in the peninsula of Yucatan, and it is planned to tie that peninsula into the Cristobal Colón Highway and thus to the rest of the Republic.

Besides the work carried out directly by the federal government, some construction is also done by local highway boards under a system of federal aid to the states. Highways built under this sytem form an important net.

The highway system under the management of the National Highway Board has a total length of more than 13,500 miles, of which 60 percent is paved, as indicated in Table 1. Roads under the control of the Maintenance Department total 5,430 miles, and those in charge of the Department

FIG. 1. MEXICO'S HIGHWAY SYSTEM consists of over 13,500 miles of paved or surfaced routes and many thousands of miles of secondary roads. Present construction rate is 2,500 miles of both main and rural roads annually, and this rate may be surpassed in 1950.

TABLE I. LENGTHS OF MEXICO'S HIGHWAY SYSTEM, JUNE 1949, IN MILES

Department	Earth Surface	Gravel Surface	Asphalt Surface	Totals
Maintenance	70	300	5,080	5,450
Construction	350	1,460	440	2,250
Federal Aid	1,200	2,440	2,240	5,880
Totals	1,620	4,200	7,740	13,580

of Construction total 2,250 miles. In 30 of the 32 political subdivisions of the Republic local highway boards are responsible for the technical control and supervision of the state highways, which have a length of 5,880 miles.

Plans for 1952

Mexico proposes to continue the highways already under construction so that they will be completed and paved by 1952. By that year it is expected that the system of principal paved highways will have a length of 8,000 miles and that a considerable addition will have been made to the mileage of the state highways.

Local Conditions Affect Road Building

J. FRANCISCO RODRÍGUEZ CABO, M. ASCE
Assistant Director of Highways, Ministry of Communications, Mexico City

TO UNDERSTAND the topography of Mexico a plain map of the country is not enough. It is necessary to go over maps marked with elevations or contours, to examine models in relief, to travel across a good number of highways and to make several flights over the country. Only so can the engineer come to understand the very mountainous character of the country, which has few level sections and many rivers flowing to the coast. Thus the majority of the roads have a high earthwork volume, and bridges and culverts are numerous. These conditions naturally affect both initial and maintenance costs for Mexican highways.

In round figures the area of the country is 760,000 sq miles and the population is around 28 millions. Considering its area, the country is sparsely populated. Although Mexico has several kinds of climate—tropical, moderate and cold—its highway engineers do not have to worry seriously about freezing and thawing in bases and pavements. However, during the rainy season there are very serious drainage problems.

In spite of the fact that street congestion in Mexico City is usual and parking space is insufficient, there are only 280,000 cars registered throughout the country, 43 percent of them trucks and buses and the remainder private cars and taxis. Nearly a third of all these vehicles are concentrated in Mexico City.

The highways around Mexico City, within a radius of about a hundred miles, have a high traffic average of about 2,000 cars per day. (Some of these highways need to be reconstructed.) The country's remaining highways have a low average traffic which, it is hoped, will increase in the future. Related to traffic is the regulation of total vehicle weight, and permissible maximum axle weight to avoid pavement destruction and the collapse of bridges.

Mexico has a great variety of soils and natural materials for construction but these are not always distributed to the best advantage for highway construction. There are places where only sandy soils exist and other places where the only soils available are clay so that granular stabilization is out of the question. In certain

BETWEEN GUADALAJARA and Tepic the Mexico City–Nogales Highway required heavy construction.

PIERS FOR HIGHWAY BRIDGE over Florido River near Durango, Mexico, are typically built of masonry with much hand labor.

MECHANIZED EQUIPMENT facilitates work on Mexico's current accelerated highway program. Selected conglomerate dug from pits (above, left) is mixed and spread for base course on Mexico City–Juarez Highway (above, right).

regions gravels are obtainable from natural deposits or river beds for use in base courses, also conglomerates and disintegrated rocks that meet the specifications for this purpose. When suitable natural materials are not available, crushed rock is used. Generally there is plenty of rock for masonry and riprap. Only in special cases do concrete aggregates have to be hauled for long distances.

The Research and Laboratory section of the Highway Department is studying the following natural materials to determine their utility: "tepetates," natural sand-clay mixtures which occur in compacted or semi-compacted deposits; "choy," deposits of various colors, a type of rock which readily disintegrates when subjected to the usual atmospheric agents; "sascab" a calcareous conglomerate; and "jales" of volcanic origin, usually with a large percentage of fines.

Among the manufactured materials used that do not have to be imported are portland cement; asphalt and other products from the abundant oil deposits along the coast of the Gulf of Mexico; and steel for reinforcing bars and for structural sections up to 15 in. in depth. Larger sizes in structural steel and corrugated sheet steel for culverts are imported.

Local materials are hauled to the job over the road that is under construction but for long hauls the railroads are used in spite of the delays involved. In some cases the still slower method of ship transportation is used. Occasionally resort is had to transportation by air, but on account of its very high cost such transportation is limited to personnel, small repair parts, and light materials and equipment.

J. Francisco Rodríguez Cabo, M. ASCE, Assistant Director of Highways, Mexico

During the early years of road building in Mexico hand labor was used almost exclusively for earthwork. Recently mechanized equipment has come into increasing use. At present, contractors as well as the Maintenance Department, have sufficient mechanized equipment, although in some cases hand labor is still found to be more economical.

Wages and unit prices have been increasing, and local conditions must be considered before a comparison can be made with similar factors in other countries. The Ministry of Communications' bureau in charge of highway construction and maintenance, called the Direccion Nacional de Caminos, is similar in organization to the Bureau of Public Roads of the United States. It is under the direction of Ing. Armando Salinas, Director General of Highways.

In order to understand the work carried on by this bureau it must be further explained that: (1) After location surveys are completed, National Highways are built by the federal government by contract at unit prices previously determined; (2) National Highways are maintained by the federal government by direct administration; and (3) there is a federal-aid system by which the states and the federal government each contribute 50 percent of the construction and maintenance costs of state roads. Recently a bureau has been created for the construction of rural roads and trails, under the Ministry of Communications and Public Roads.

Contributed Local Labor Builds Rural Roads

RENE ETCHARREN GUTIERREZ

Head, Department of Secondary Roads, Ministry of Communications and Public Works, Mexico

APPEARANCE OF the automobile in Mexico in 1906 radically transformed the transportation picture and stimulated more road building than had occurred in the whole previous four hundred years of the country's history. However, the political and social struggles that shook the country starting in 1910 prevented the rapidly succeeding governments from giving attention to the improvement of the antiquated roads, until fifteen years later, in 1925, when a stable government was achieved.

Rene Etcharren Gutiérrez, Head, Department of Secondary Roads, Mexico

ECONOMY DICTATES USE of locally produced materials as much as possible for Mexico's highways, including abundant asphalt deposits along coast of Gulf of Mexico. Asphalt plant (above, left) mixes and loads black-top paving material for Mexico City-Juarez Highway (above, right).

The Ministry of Communications and Public Works then created a National Highway Commission which immediately flung itself into the task of building roads as fast as possible.

Because of the urgent need for first-class highways it was not possible to give attention to secondary roads. As a result, the villages, ranches and small population centers, which constitute the greater part of the nation, stayed buried in mud and dust. Roads that had formerly been satisfactory for mule bearers, "charros," and carts, proved inadequate for automobiles and trucks. Cognizant of the magnitude of this problem, President Alemán on May 14, 1947, issued a decree creating the Department of Secondary Roads.

Secondary Road Needs Vary Widely

The extent of the problem can be gaged from the fact that an estimated total of at least 62,000 miles of secondary roads are needed in Mexico. In many cases old routes can be improved to create all-weather rural roads. In other cases the old roads must be rebuilt entirely. Some parts of the country, now isolated, which have high agricultural, cattle-raising or mining potentialities, need only simple rural roads for their development. In building secondary roads, including farm-to-market roads, mail routes, feeder roads and penetration roads to isolated areas, degree and type of use and relative importance must be taken into consideration. Requirements vary widely, ranging from first-class design and alignment to the single-lane rural road which can economically wind up to the summit of a mountain.

Even before the arrival of the Spanish Conquerors the "tequio" was being practiced by the native tribes—a procedure whereby members help one another in the construction of buildings, roads, and temples. In other areas there is the custom known as "faenas," according to which each inhabitant obligates himself to work gratuitously on a certain public work. Such an individual, if he has sufficient means or has some other work to do, can arrange for a paid workman to represent him in his faena. Both the tequio and the faena are practical demonstrations of the people's deep desire to cooperate spontaneously and gratuitously in public works.

During the early efforts of the Department of Secondary Roads, both enthusiasm and interest have been displayed by private individuals and institutions, which have shown willingness to cooperate in the construction of rural roads. This willingness has been put to use in two ways:

1. The Department supplies technical direction, tools, and building materials to villages which contribute the necessary labor. Such technical direction has a decided psychological effect and tends to stimulate and maintain interest in the work.

2. In areas where the economic level is higher, the assistance from private interests is contributed in the form of money to help defray the cost of road construction.

In both the cases described above, the state government also contributes, making it possible to divide the necessary outlay in three parts, thus opening up an extensive field of action.

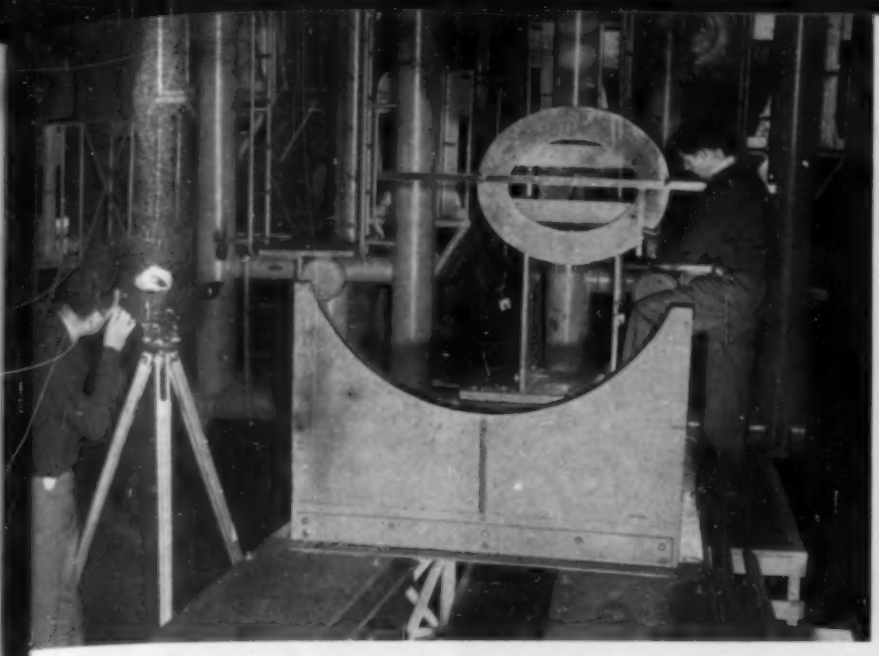
With an initial yearly budget of $230,000 the Department of Secondary Roads has started to build roads of several types in different parts of the country, taking advantage of every available offer of assistance. For example, on the road between Tlaxiaco and Yosondua, State of Oaxaca, which is 44 miles long, 3,336 men volunteered to work at least three days a month, thus making available a crew of more than 300 men every day.

During the first year of the secondary road program, 280 miles of rural roads were constructed, ranging from single-lane penetration roads to well-aligned 20-ft routes with surfacing material on the whole width and corresponding appurtenant structures. Including the assistance received, these roads have cost $2,800 per mile, of which $825 per mile was contributed by the Department of Secondary Roads.

Increased Production Due to Road Building

Results of this work have been immediate and in some cases amazing. In the valleys of Zamora and Ixtlan, in the State of Michoacan, agriculture has already increased since the road was built. Production of potatoes increased from 2,200 tons in 1946 to 13,000 in 1948, and production of tomatoes increased from 3,000 to a million cases. In Zamora, the place where gasoline is sold for both the Zamora and Ixtlan Valleys, the sale of gasoline increased by 720,000 gal in these two years, and instead of a total of 261 freight trucks operating in 1946, truck registrations at the beginning of 1949 totaled 416. The taxes collected on this increase in the gasoline consumption in the Zamora Valley, at the rate of 4.4 cents per gal, amounted to $31,700.

The total cost of 62,000 miles of rural roads, if the average cost of $2,800 per mile is maintained, will be $170 million, to be divided equally between the state governments, private individuals and institutions, and the federal government. This job is not one that can be accomplished in two or three years. It will require the interest and effort of all concerned over a considerable period of time. But with the continued enthusiastic cooperation of local groups, a highway or railroad can be brought within easy reach of each of the country's 105,000 villages and farming communities with less than 5,000 population which now are almost totally isolated.



SURVEYING TECHNIQUES AND INSTRUMENTS establish horizontal plane (above, left) and vertical plane (above, right) at horizontal longitudinal center line of a jig. Fairchild Engine & Aircraft Co. and Eugene Dietzgen Co.

Surveying Instruments Enter the Shop

New Techniques Demanded for Precision in Large Parts

PHILIP KISSAM, M. ASCE

Professor of Civil Engineering, Princeton University, Princeton, N.J.

SURVEYING IN THE SHOP is still a very new process, but one which promises a whole new field of endeavor to the civil engineer by reason of his familiarity with surveying techniques and instruments. Strange as it may seem at first glance, surveying instruments have important assets which are lacking in shop measuring equipment. For instance they can easily provide an accuracy of one-thousandth of an inch at 20 ft. However, to attain such accuracy under shop conditions, the usual field procedures must be modified and new methods developed. Professor Kissam outlines the problem and makes suggestions for its solution in the following article, based on the paper he delivered before the Surveying and Mapping Division at the Washington, D.C., Fall Meeting.

MANY PROBLEMS in industrial surveying are much the same as in surveys for construction. Maps and profiles are required as a basis for industrial facilities and surveying techniques are used for controlling construction and installation. But the American surveyor is now faced with a brand new problem in industrial surveying for which he is ill equipped. This problem has been created by the important movement in this country toward the building of very large products with interchangeable parts. It is clear that this development is not a flash in the pan, but a permanent trend. Heretofore, interchangeability has been confined to parts of small dimensions. Standard shop practices have been developed to produce the desired accuracies. Control gages, precision bench plates, indicators, and the like have successfully produced the near-perfect jigs that have controlled the products.

But during the past war the airplane industry was suddenly confronted with the necessity of making airplanes with interchangeable parts. This required great jigs built to very small tolerances. Standard shop practices could not handle the job and surveying practices began to make their way into the shop. Gravity as a reference direction supplanted the bench plate; optical sights took the place of wires, straight edges and indicator gages. Surveyors found themselves faced with new problems. Thousandths of an inch replaced the hundredth of a foot as a unit of measure. Sights a few inches long were required instead of hundreds of feet.

Assets of Surveying Instruments for Shop Use

There are three important assets inherent in surveying instruments not found in shop measuring equipment. The first is the use of gravity for a reference direction. The spirit level gives the direction of gravity to such a degree of accuracy that a thousandth of an inch can be recognized at 20 ft. In shop practice a reference direction is established by a flat metal surface—a bench plate. It is machined to a high degree of flatness. But a bench plate cannot be kept accurate if it is much larger than 24 in. in any direction. Temperature changes and variations in support alone introduce curvatures that destroy any accuracy of manufacture. With a surveying instrument, nearly perfect horizontal planes, absolutely parallel with each other, may be established wherever desired.

The second asset is the superb qualities of the optical sight. With a good target, the probable error of observing the position of a point is 0.3 sec of arc. The observer is definitely conscious of 1.0 sec, which is 0.001 in. at 20 ft. When a spirit level is combined with an optical sight, the combination will produce a horizontal plane at any level desired with a probable error of not more than $^1/_2$ sec of arc. This accuracy corresponds to that of a bench plate 40 ft in diameter, held to a tolerance of 0.001 in.

The third important asset is the quality of the azimuth and elevation bearings combined with the reversibility of the transit instrument. These bearings provide nearly pure rotation for the line of sight. By reversing the instrument it is possible to adjust the relative position of these bearings and the line of sight so that nearly perfect vertical or horizontal planes can be generated

WYE LEVEL is mounted on elevating post for shop use. Boeing Aircraft Co.

wherever desired. There is no shop equivalent able to establish two planes at 90 deg to each other with comparable accuracy.

Limitations of Surveying Instruments

While surveying instruments are capable of establishing the relative orientations of planes to a very high degree of accuracy, these results are not attained without great care on the part of the observer. Usual field procedures must be considerably modified and new methods introduced.

For giving line and grade in the field the most important geometric requirement of the transit is that the line of sight be perpendicular to the elevation axis. This condition is usually carefully maintained by most transitmen so that a line can be prolonged by reversing the instrument without double centering. Other relationships are comparatively unimportant in the field. The telescope bubble may be slightly out of adjustment, as it costs little more to balance the length of sights than to use unbalanced sights. The perpendicularity of the elevation axis to the azimuth axis has little effect, as only seldom is the line of sight inclined at a high angle, so that reversal is not costly.

In the shop, so many observations are made at high angles that it is impractical to reverse the instrument. This circumstance magnifies the importance of the perpendicularity between the axes. Accordingly, this relationship must be carefully adjusted. Level shots cannot be conveniently balanced. Thus the telescope bubble must be in perfect adjustment. Very short sights must be taken so that the focusing slide must be perfectly aligned. In fact, since the instrument can seldom be reversed without serious loss of time, every transit adjustment must be nearly perfect, except perhaps that of the vertical circle.

Since sights at high vertical angles are used constantly, great care must be exercised in leveling. It is nearly essential that the telescope level be used for leveling at every set-up. Also it is impossible to place the instrument on a desired line to the required accuracy by merely setting up over a point with a plumb bob. In every case the instrument must be "wiggled in" so that the line of sight itself is aligned with the desired points. This process of course, is decidedly tedious. It requires releveling at each trial and the trials must be continued until the line of sight is within a few thousandths of an inch of the desired position. Several methods have been tried or suggested to overcome this difficulty.

One of the first efforts to simplify wiggling-in was to mount the instrument on a small carriage which slides laterally on a short pair of ways like a lathe tool. With this device it is possible to shift the instrument without deranging the level very much, but unfortunately it is always necessary to relevel, thus disturbing the line of sight and requiring another shift.

Frequently it is necessary to set the line of sight at a predetermined height. This procedure is next to impossible with an ordinary tripod. The instrument must be mounted to a vertical post with an adjustable inside support that imparts nearly linear motion. This device usually disturbs the alignment slightly and always disturbs the level.

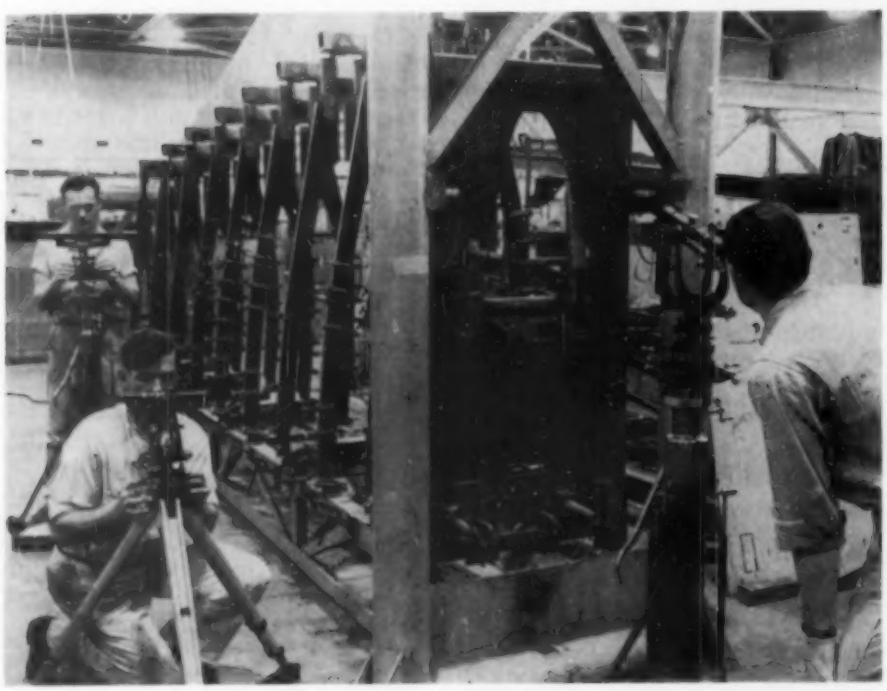
Another scheme is to aim a collimator at the cross hairs after the instrument has been brought nearly into position and the line of sight leveled and aimed parallel to the points required. Alignment can then be tested very quickly thereafter by sighting the collimator. However, if it is necessary to establish a plane, the instrument must be releveled and the method reverts to cut and try.

Use of Plane Parallel Suggested

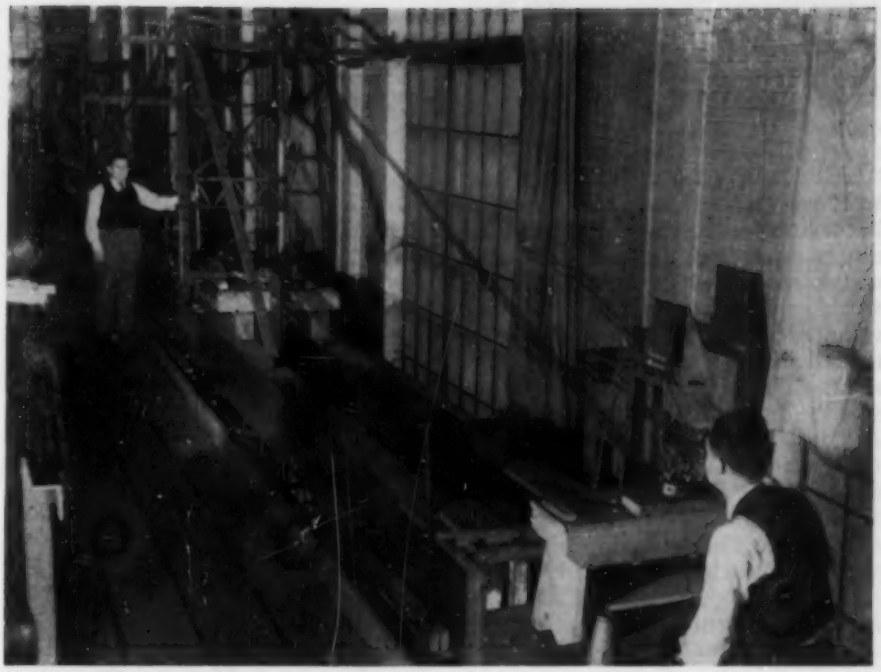
The writer suggests that a plane parallel be mounted in front of the objective, as is done on some of the German levels. When the plane parallel is rotated, the line of sight is moved parallel to itself, the translation being in the plane of rotation. If the device is mounted so that its axis of rotation can itself be rotated around an axis parallel to the line of sight, the line of sight can be translated in any desired direction. Except in the unusual case when vertical or horizontal angles must be measured from a given point, the parallax introduced would not affect the results.

With an engineers' transit, that is, one equipped with a telescope level, properly used, it is possible to establish a horizontal plane and also a vertical plane in any desired azimuth. Development in the future should provide a means of easily placing these planes where desired.

When a jig is to be lined up, it is almost essential that the jig be sup-



SURVEYING EQUIPMENT aligns jig for airplane wing section. C. L. Berger & Sons and Douglas Aircraft Co.



DEFLECTIONS IN MODEL suspension bridge are measured by surveying instruments. John A. Roebling's Sons Co.

ported so that the planes to which the dimensions are referenced are placed vertical and horizontal. Any other procedure requires voluminous computation. Usually the jig can be placed in nearly the proper orientation before precise measurements are established on it. The reference frame can then be precisely established in accordance with the direction of gravity.

If precise points already exist on the jig, the first step is to jack the jig into position so that the horizontal reference plane is exactly horizontal. This, of course, is a difficult cut-and-try procedure. Thereafter the transit is placed on the desired vertical planes, as required, by wiggling in.

Measurements are made from the line of sight to the various parts to be located with steel scales or measuring bars with caliper ends. When in position they are permanently attached to the jig by various means. Probably the most popular method is to seal them in position by an alloy called cerromatrix, which melts at low temperatures.

Problem of Very Large Jigs Solved

During the war it was found nearly impossible to build two large jigs, to the same plans, that were exactly alike. To overcome this difficulty, a master dummy part was first constructed according to the original drawings, using surveying techniques for measurement. The necessary jigs were then made to fit it. When two factories were making the same airplane it was necessary to ship the master dummy from one factory to another. The shipping problem became very acute as the size of the airplanes increased.

A remedy for this difficulty has been devised by British engineers. Their scheme is to make the jigs in many small parts, each carrying extremely accurate reference points well arranged for accurate observation by optical lines of sight and direct measurement. The parts are small enough to be made precisely in accordance with the drawings.

Each jig section usually carries four reference points, about $1\frac{1}{2}$ in. in diameter, which are targets. They are actually glass reticules provided with cross lines. The reticules are mounted in metal rings, each of which is accurately machined to a standard thickness and diameter. The glass is carefully mounted so that the cross hairs are exactly centered. The target assembly is held to the jig section by a special container from which it can be removed and replaced in the same position. The container has screws for adjusting its position. The targets are adjusted to the jig by measurements to the rings so that the cross hairs are placed on two parallel level reference lines which run at the same height throughout the entire jig. The targets are carefully spaced along these lines according to the drawings. The entire operation of placing the targets on the jigs can be completed by ordinary shop methods.

The jig is assembled wherever desired by aligning all the targets and spacing them by measurements with measuring rods equipped with micrometer ends. The reference lines are established for the assembly by mounting two collimators, each provided with a level, on a frame at one end of the jig, and viewing each of them with a telescopic sight mounted on a frame at the other end. All four optical devices are mounted in wyes for easy collimation. Targets placed in front of each collimator objective are set at the proper separation by the measuring rods. The collimators are leveled. One telescopic sight is aimed at the cross hairs of the collimator by focusing at infinity. The sight is then focused on the target and shifted parallel to itself until it points on the cross lines. By alternately focusing on the cross hairs of the collimator and then on the target, the telescopic sight is finally made parallel to the collimator and yet on line with the target.

The second telescopic sight is worked into position in much the same way except that it must be placed in line with two targets, one at the objective of its collimator and the other near its own objective. Both targets are spaced laterally by measurements from targets placed on the first reference line. Thus the two lines are level, as they are parallel with the leveled collimators. They are also parallel in a horizontal plane as they are equidistant at both ends. The various jig parts are then set by placing their targets on these references lines and spacing them along the lines by measurement.

It is clear that surveying in the shop is still a very new process calling for many improvements. Very few production engineers are sufficiently familiar with the possibilities inherent in surveying equipment to utilize them to the best advantage. Very few surveyors are familiar enough with the requirements of the shop to realize what precision techniques are required. And finally, very few individuals are sufficiently versed in both surveying methods and shop problems to contribute to the necessary instrumentation.

Surveyors should give some thought to this new field of endeavor, study the problems of the production engineer, develop the proper techniques, demand the proper instrumentation, and finally advise the production engineer on the solutions of the new and difficult measurement problems that now confront him.

Photographs are reproduced by courtesy of McGraw-Hill Book Co. from the author's book, *Surveying*.

Cartographers Consider International as Well as National Mapping Needs

"DURING AND SINCE the last war, we in the United States have become more and more internationally minded. Our responsibilities in collaborating with the rest of the world in working out the peace have required us to be more deeply concerned in the mapping of foreign areas than we ever were before the war." In these words Robert H. Randall, M. ASCE, introduced the theme of his paper on "International Cartography," read before the Surveying and Mapping Division at its session on Thursday morning, November 3, at the ASCE Fall Meeting in Washington, D.C. Mr. Randall is Chief Examiner, Surveying and Mapping, U.S. Bureau of the Budget, Washington, D.C.

Activities of the U.S. Coast and Geodetic Survey formed the subject of the second paper presented at this session. The author, Rear Admiral L. O. Colbert, M. ASCE, Director of the C. & G.S., told the Surveying and Mapping Division that one of the formidable tasks facing the Survey is the extension of geodetic control into the heart of Alaska. Another significant project now under way is the reconstruction and extension of horizontal control in Hawaii.

A note of warning was sounded by W. E. Wrather, Director of the U.S. Geological Survey, Washington, D.C., the next speaker on the program. He stated that our store of detailed terrain knowledge in the United States, in the form of good topographic maps, is very low. At the present rate, sixty years will be required to complete the adequate mapping of the nation. However, he expressed the optimistic belief that the nation is now becoming map conscious, perhaps for the first time in its history.

In the last paper presented at this session, Philip Kissam, M. ASCE, Professor of Civil Engineering, Princeton University, discussed recent criticism of the transit and concluded that "the American engineer's transit has been demonstrated to be the best instrument available." The second part of his paper, devoted to the subject of new uses for surveying techniques and instruments in industry, appears as an article elsewhere in this issue.

This session of the Surveying and Mapping Division was presided over by George D. Whitmore, M. ASCE, Chairman of the Division's Executive Committee and Chief of the Research and Technical Control Branch of the U.S. Geological Survey, Washington, D.C.

Abstracts of papers received at Society Headquarters prior to the Meeting appear below.

Robert H. Randall

Map makers are becoming more and more internationally minded, Mr. Randall said. "Now that modern transportation and communication facilities have brought all of us on the planet within gun-shot of one another, reducing the world in a very real sense to a rather small community, our need is for the geographic knowledge which basic maps and charts supply so that we may be able to know our neighbors and their environment and institutions, and consequently to work with them for the common good."

As far back as 1940, Mr. Randall continued, a group of United States

George D. Whitmore, Chairman, Executive Committee, Surveying and Mapping Division; Chief, Research and Technical Control Branch, U.S. Geological Survey, Washington, D.C.

Government officials and representatives of scientific organizations decided that something should be done to bring about closer cooperation and better understanding among the nations of this hemisphere in carrying out their surveying and mapping programs. An existing organization, the Pan American Institute of Geography and History, was chosen as the instrument of this cooperation. As a result, at the Institute's Third General Assembly, held in Lima, Peru, in March–April 1941, a resolution proposed by the United States delegate was adopted whereby the Institute's Commission on Cartography was created. Since then the Commission has chalked up numerous accomplishments to its credit besides promotion of Inter-American friendship.

Among its accomplishments mentioned by Mr. Randall are: Adoption of uniform standards for geodetic operations, standard specifications for topographic maps, standard specifications for the production of the 1 = 1,000,000 scale aeronautical charts, standardization of methods for geomagnetic observations and tidal work, production of a glossary of standard cartographic terms, publication of a manual on geodetic control surveys, and production of narrative and training films on cartographic subjects. These films, the speaker said, besides being circulated in the Americas, have attracted attention in other parts of the world.

Other organizations engaged in international cartographic activities, Mr. Randall said, are the International Hydrographic Bureau and the International Civil Aviation Organization, both of governmental character; and the International Union of Geodesy and Geophysics and the International Geographic Union, both of professional character. The latter has been instrumental in establishing the Central Bureau of the International Millionth Map of the World, responsible for coordinating the production of the world series of maps at the scale of 1 = 1,000,000.

Mr. Randall then outlined the efforts that have been made within the structure of the United Nations to further the cause of international cartography and to coordinate the cartographic services of the United Nations and its specialized agencies. In February 1948, the Economic and Social Council adopted a resolution put by the Brazilian Delegation recommending that the member governments stimulate accurate mapping of their territories and that the Secretary-General further such efforts by promoting the exchange of technical information and by other means and also coordinate the plans and programs of the United Nations and specialized agencies in the field of cartography.

Leo Otis Colbert

Speaking of the close cooperation which exists between the Coast and Geodetic Survey and the U.S. Geological Survey, Admiral Colbert said that the former gives priority in its horizontal and vertical control program to those areas where topographic surveys are contemplated.

The horizontal control work was begun, the speaker said, with widely spaced arcs of triangulation, which today are being filled in, as the needs of the country's agricultural, urban, metropolitan and industrial regions require. Today there are more than 100,000 miles of arcs of first- and second-order triangulation in the United States, with monumented stations established at an average of about 10 miles along the various arcs. Geographic positions (that is latitude, longitude and azimuth) have been determined for about 150,000 stations consisting of monumented points and prominent objects such as water tanks, church spires, cupolas and chimneys. To facilitate the use of the networks he explained, at each monumented station an azimuth mark is established at least a quarter of a mile distant to furnish directional control.

As for accuracy, Admiral Colbert said that for first-order work the average triangle closure must not exceed 1 sec, and the lengths as carried through from one measured base to another must agree on an average of about 1 part in 75,000. With a spacing of 40 to 60 miles square between arcs, usual discrepancies can be absorbed, he said, without violence to the observed values. "We are establishing at least one triangulation station in each $7\frac{1}{2}$-min topographic quadrangle. We are also providing stations at 4-mile intervals along main highways in agricultural areas and closer spacing in metropolitan areas. To coordinate local urban surveys we establish at least one base line in metropolitan areas of 100,000 population or over."

In the distribution of vertical control, the speaker stated, a similar principle has been followed, starting with widely spaced lines of levels followed by intermediate lines, and finally by area leveling. The present program calls for first-order lines spaced 100 miles apart and second-order lines 6 miles apart for certain areas such as the large river basins.

At present there are more than 360,000 miles of first- and second-order leveling in the United States and upward of 275,000 established bench marks, Admiral Colbert stated. Most of the lines follow highways and railroads, and bench marks are established at 1- to 2-mile intervals.

In recent years, he said, the Survey has been engaged in establishing geodetic control in some of the larger river basins, most prominent of which are the Columbia and Missouri Valleys, in anticipation of the multiple water-use projects to be undertaken there. Close contact is maintained with federal, state, county and municipal organizations which use control surveys and an effort is made to plan the Survey's field work to take care of the most urgent needs. The field personnel last summer numbered about 300 men. The work load at present is about three times in excess of what can be done with funds available.

One of the formidable tasks facing the engineers of the Survey, the speaker said, is the extension of geodetic control into the heart of Alaska. Triangulation surveys are now in progress in western Alaska and along the Arctic coast. Alaska is already tied into the continental United States by arcs extending from Puget Sound through southeast Alaska and along the Alaska Highway in Canada through the center of Alaska to Cape Prince of Wales and the Little Diomede Island in Bering Strait with a spur through the Aleutian Islands.

Another significant project under way at present is the reconstruction and extension of horizontal control in the Hawaiian Islands. Monuments destroyed or uprooted during the war will be reestablished and closer spacing of monuments effected in anticipation of a mapping program planned for the Islands by the U.S. Geological Survey.

In closing, Admiral Colbert urged engineers to help the bureau preserve the many thousands of triangulation monuments and bench marks which it has established throughout the country.

W. E. Wrather

"Our store of detailed terrain knowledge—good topographic maps—is exceedingly low," Mr. Wrather brought out in his paper. "This is a serious situation," he stated, "in view of the development programs currently authorized by the Congress." Proposed federal expenditures during the next several decades for water resource projects alone, he said, are estimated at more than 52 billion dollars. Quoting Col. E. R. Needles, president of the American Road Builders Association, he declared that 60 billion dollars and from 15 to 20 years would be required to extend and improve our highway system for handling present and anticipated traffic. With programs of such magnitude in prospect, complete topographic information should be available, Mr. Wrather declared, "but unfortunately this is not the case."

"The failure to provide for the implementation of the Temple Act (of 1925, providing for the complete mapping of the United States)," the speaker said, "resulted in a shocking lack of maps necessary to plan for the defense of this nation against invasion when the second World War started. Since trained technical personnel did not exist in sufficient numbers and really modern equipment was not available in quantity, many of the maps prepared as a part of this emergency program are substandard. It is inconceivable that we should ever permit a recurrence of this deplorable situation, with its inevitable waste of public funds."

Although during the past 70 years topographic maps have been prepared for about half of the United States, Mr. Wrather said, only one state, Massachusetts, can be considered adequately mapped by present standards. This is because Massachusetts has maintained a program of remapping and revision to keep its maps up to date. Less than 25 percent of the country as a whole is adequately mapped by current standards, he said.

At this time about 2,000 quadrangles, or individual maps, are in progress throughout the 48 states, Alaska, Hawaii and Puerto Rico, and 400 are completed annually, the speaker stated. At this rate, equivalent to about 40,000 sq miles annually, the entire area of the country would not be adequately mapped until about the year 2010, or 60 years hence.

The Geological Survey has outlined a program by which the inadequately mapped areas of the United States will be covered within the next 20 years. The estimated cost of this mapping averages 25 cents per acre, Mr. Wrather said, or an expenditure of between 400 and 500 million dollars in the next 20 years—only a fraction of 1 percent of the estimated cost of anticipated federal and state construction and development programs within this period.

In closing the speaker sounded the optimistic note that as a nation we are, perhaps for the first time in our history, really map conscious. Large cooperative mapping programs have recently been initiated by several states, including North Carolina, Connecticut, Kentucky, Tennessee and Minnesota. Other states have programs which will assure completion of their mapping in the next decade. The large unmapped areas of public domain in the West, however, depend on an expanded federal program to meet their needs.

White House Renovation Project Preserves Original Features of Historic Structure

W. E. REYNOLDS, M. ASCE
Commissioner of Public Buildings, Washington, D.C.

RECONSTRUCTION OF the White House to eliminate recently discovered structural defects has been studied by engineers and architects and debated by legislators during the past year. With final Congressional authorization for renovation while preserving the historic features of the famous edifice, work on the project is getting under way. A description of the rehabilitation work, which will involve only the main or central edifice, is presented here by Commissioner Reynolds in a paper originally delivered before the Structural Division of the ASCE at its Fall Meeting.

THERE IS no phase of the profession in which the old adage, "Be sure your sins will find you out," is more certain of fulfillment than in structural engineering. Engineers have seen it proved from little bungalows to big bridges. The law of gravity or the principles of stress and moment cannot be evaded or ignored without ultimate payment.

The most interesting proof of this in the popular mind today is the White House situation. Some facts and considerable conjecture that is not true have been printed about its recently discovered structural shortcomings. Though many such shortcomings do exist, it is only fair and only sensible to recognize the fact that long strides in structural know-how have been made since 1790, when James Hoban won the competition for design of the "President's House." It must be remembered, too, that not much money was available for the project, and that part of the funds had to be raised by the sale of lots in the new Federal City. That wasn't easy to do in the 1790's, when muskrats were being trapped in the swamp lands where some of Washington's proudest buildings now stand. So Hoban had to do the best he could with what he had. The years have demonstrated that he did a highly commendable job.

Three Major White House Renovation Projects

Since its completion 140 years ago, the White House has undergone three major operations. Any one of these could have affected and probably did affect its structural stability, as have also the countless minor changes here and there that were not contemplated at the time Hoban made his original design.

The first major rehabilitation was accomplished under Hoban's supervision after 1814, when the building was gutted by fire set by the British. With the interior constructed mainly of combustible materials, the fire completely destroyed the first, second, and attic floors, the wooden partitions and the roof, and badly damaged portions of the exterior walls above the ground floor. The greater part of the basement story walls were not seriously damaged, though some of the exterior walls had to be rebuilt. When the work was finished, the whole building was painted white—probably to cover the scars of the fire on the parts of the original walls remaining in place, and possibly because the new stone used in reconstruction was of a slightly different color. It may have been about this time that the building was first referred to as the "White House," although the name was not officially authorized until early in this century.

By the time the next major rehabilitation was undertaken in 1902, during the administration of Theodore Roosevelt, the White House had begun to show the effects of generations of wear and tear. Moreover, the Executive Offices occupied so much of the second floor that very little remained in the way of comfortable living quarters for the President and his family. To remedy this situation, Congress appropriated $475,445 to extend and remodel the first floor in order to provide more adequate apartments of state; and to construct a temporary Executive Office Building at the end of the West Terrace. The architectural firm of McKim, Mead & White was retained for the work, which included enlarging the State Dining Room and rebuilding the East Terrace. The public reception rooms were made structurally sound, and the President's living quarters improved and modernized.

The third major renovation project, which was completed in 1927, involved reconstruction of the roof supports and the third or attic story, which had been built entirely of wood in the restoration following the fire of 1814. The roof construction consisted of 10 large main trusses, 83 ft in length, spanning from wall to wall, and 10 jack and hip trusses. The main trusses were of very heavy timber, the lower chords being 12 × 12 in. and the upper chords and web members only slightly smaller.

In reality, the third story was an attic supported on the lower chords of the roof trusses. Before the construction of the Executive Office, the third story was used for storage and as a file room for the Executive Office records. Since the roof trusses were not designed to carry any appreciable load on the lower chords, the heavy dead weight thus placed on the third floor created excessive stress in the connections, causing complete or

partial failure in many instances. This, together with the necessity for cutting into the chord timbers for alterations, caused sagging of the third story. The weakened joints were braced with metal straps and the trusses were supported at points on the partitions below.

In 1926 an appropriation of $375,000 was made to correct this condition by reconstructing the roof, third story, and second story ceiling. No contract was made for reconstruction of the second story. New steel roof trusses were erected, and the third story was completely rehabilitated to provide nine guest rooms and four servants' rooms.

When the work was finished in August 1927, the White House had first and third stories of fire-resistive construction and, except for an inconsequential amount of non-fireproof structural steel introduced in 1902, a wood-constructed second story dating back to the restoration after the fire of 1814.

Few Changes Since 1927

There have been relatively minor changes since 1927. In general, then, we are down to date, and to the nub of a very good question put to me by a Senator at a committee hearing. He said, "If the structural condition of the White House is so bad, why didn't we know about it before this?" The answer is obvious. We don't know a child is coming down with the measles until it develops a rash; then we call the doctor. No one knew the White House was a very sick building until a symptom of the sickness appeared. That symptom was a vibration of the floor in the President's study which the President noticed when someone walked across it. There had been no previous reason to believe that the supports of the second floor were structurally inadequate, but immediately on getting the President's request, we made a superficial survey. What we found indicated the need for an intensive structural investigation of the entire second floor. At the outset of the investigations, we expected to find that all the building needed was a new second floor of fire-resistive construction and air conditioning of the first floor, with provision for later extension to the second and third floors.

Intensive Investigations Started

Initial studies consisted of cutting holes at strategically selected places in the second floor. While it is manifestly impossible to detect all weak spots from inspection holes, or to discover all the damage done in installation of gas, water, and sewer piping, we did uncover sufficient evidence to convince us that a critical condition existed in the supporting timbers. Those under the President's study were inadequate for the size of the room and were the cause of the deflection or vibration that had attracted attention. This condition was found to be general throughout the second floor, except over the East Room.

The structural timbers were tested and identified by the Forest Products Laboratory as short-leaf pine of excellent quality. Probably they were entirely adequate when installed, but some 130 years of structural changes have resulted in imposition of both live and dead loads beyond those originally anticipated. For one thing, the provision of bathrooms for the second story, between 1874 and 1902, imposed a severe additional load on the floor timbers. Also, the installation of plumbing involved extensive cutting into the joists. In the President's bath, the normal depth of the floor joists is 11 in. To install the drains, three of the joists had been cut down to a depth of 2 in. In other bathrooms, the joists had been cut entirely through, leaving their ends resting on 1 × 4-in. boards laid on joists of the first-story ceiling. It is a tribute to the toughness of good timber that it has successfully withstood such abuse for so long.

Timber Depth Reduced from 18 to 5 Inches

Enlargement of the State Dining Room in 1902 required removal of a brick bearing wall on the south side of the main corridor, which previously was one of the supports of the second story. The substitute support consisted of 10-in. steel beams. To meet architectural requirements, the existing wood girders were notched at the supporting ends to receive the new steel beams. This left about 5 in. of the original 18-in. depth of the girder timbers to carry the load. As might be expected, they split for a distance of 4 ft from their support. How any timber could stand up for 45 years under such treatment is hard to imagine—force of habit, perhaps. No indication of decay was noted in the timbers resting in the brick walls, nor was there any structural evidence of termite infestation.

A portion of the ornamental plaster of the magnificent East Room ceiling, with its three great crystal chandeliers, actually dropped 6 in. in October 1948. It was constructed in 1902 by vertically nailing wood strips to the under side of the wood ceiling beams. The plaster was supported on hardware cloth nailed to the wood strips. During the past 46 years the weight of the plaster had gradually drawn the vertical nails. It is apalling to think what might have happened had the ceiling fallen during some great state function.

Though this situation was bad enough, further investigation revealed conditions even worse. The walls of the White House are brick and stone, with exterior facing of Aquia sandstone. Cracks in the plaster and exposed parts of the brick backing directed attention to the condition of the masonry in general. The concentrated loads imposed on the exterior walls are beyond the safe working load established by the Bureau of Standards.

Overloaded Brick Wall Badly Cracked

The interior brick wall at the west side of the state stairway supports a truss at its south end that delivers a dead load of about 180,000 lb, producing a unit bearing considerably in excess of that recommended as safe by the National Bureau of Standards. This particular wall cracked from the under side of the third floor at the truss support down to the first floor, and its condition is becoming progressively worse.

The Bureau of Standards was asked to test about 15 bricks of comparable character and to examine the mortar as a basis for determining the carrying capacity of the wall. It reported that the wall had an ultimate capacity of 300 psi, which may be reduced to 200 psi under long sustained loads. The truss reaction produces an average stress of about 150 psi, but because of eccentric loading the maximum critical stress may be more than double that amount. Gages were installed to detect any movement in the wall. The measurements showed a widening of both cracks, and this movement has been determined to be progressive. Engineering consensus is that the margin of safety here approaches zero, and that the failure of this one wall could precipitate the collapse of the entire structure.

Foundation Conditions Explored

A test excavation to investigate foundation conditions and test borings to determine the character of the supporting soil were then made. These disclosed that the footings under the exterior wall were of rubble stone laid with inferior lime mortar and that no footing had been provided for the interior brick wall at the point of excavation. The borings indicated that the soil immediately

under the footings is clay containing organic matter, and that 20 ft below the foundation footing there is an excellent stratum of sand and gravel with a bearing capacity of 6 tons per sq ft. In contrast, analysis of the samples of soil underlying the exterior wall foundation verifies the classification of material from the borings and shows a degree of compressibility ranging from 2 to 5 percent under a load of 4,000 psi.

Computations based on the soil tests indicate that the soil under the east end of the north wall will safely support only one-half as much weight as that at the west end. The lack of footings under the interior walls has resulted in their settlement. This differential settlement is so great that the interior walls not only have cracked but in places have pulled an inch or more away from the exterior walls. Weakened by earlier alterations and overloaded by the weight of the floors and roof, the interior walls have settled as much as 2 in. in places.

Remedial Measures Sought

When the dangerous structural condition of the White House was finally determined, Maj. Gen. Philip B. Fleming, M. ASCE, then Administrator of the Federal Works Agency, recommended immediate vacating of the White House. As soon as this move had been made, we shored up the ceiling of the East Room and took all other possible immediate precautions against the occurrence of minor failures that might set off a chain reaction resulting in a major collapse.

Several schools of thought as to the best procedure for rehabilitation were then expressed with some heat. One advocated demolition and complete reconstruction. Another school was in favor of taking down and keeping the outer walls intact, while a steel and concrete or masonry building was constructed, and then refacing the new structure with the salvaged sandstone. The third plan was to refrain from laying what might be considered sacrilegious hands on the exterior of the building and to keep it standing "as is" in its character of a historic symbol during the work of reconstruction. This plan would consist of installing modern framework within the existing walls, to which they would be tied, resulting in a structure designed to carry all predictable loads, and resistive to fire and attack by the elements.

The discussion was resolved by legislative action creating a Commission on Renovation of the Executive Mansion. The Commission consists of Senators Kenneth McKellar of Tennessee, chairman, and Edward Martin of Pennsylvania; Congressmen Frank B. Keefe of Wisconsin and Louis C. Rabaut of Michigan; Richard E. Dougherty, Past-President of ASCE; and Douglas William Orr, Past-President of the American Institute of Architects.

Engineers Named as Consultants

The Commission has named as consultants Emil H. Praeger, M. ASCE, partner in the firm of Madigan-Hyland; ASCE President-elect Ernest E. Howard of Howard, Needles, Tammen and Bergendoff; and William A. Delano, New York City architect and former member of the National Capital Park and Planning Commission.

After a thorough study of all phases of the problem, the Commission announced that it had concluded to retain the exterior walls and roof structure, underpinning the existing walls and carrying the new interior footings to a firm stratum found about 20 ft below the present shallow foundation. The necessary excavation for this work will permit the building of a much needed basement to house the new mechanical equipment and other facilities not now available in the White House.

It is the considered opinion of all who have critically examined the problem that the White House, a symbol of the Nation and the official home of our Presidents, should be permanent and provide all the modern facilities to meet the demands placed upon it. Though the structure did not spring full-fledged from the drawing board of James Hoban, there is cause for rejoicing that its present dignity and architectural charm will be preserved unchanged for posterity.

These remarks can be closed on no better note than that of a direct quotation from Theodore Roosevelt's message to Congress in 1902 concerning the White House. He wrote: "The stately simplicity of its architecture is an expression of the period in which it was built and is in accord with the purposes it was designed to serve. It is a good thing to preserve such buildings as historic monuments which keep alive our sense of continuity with the Nation's past."

Economic Studies Determine Design and Location of $8,000,000 Soap Lake Siphon

IN ITS ECONOMIC STUDY of the design of a 2½-mile-long siphon at Soap Lake, Wash., carrying 5,100 cfs, the Bureau of Reclamation has developed a thin steel-lined concrete pipe, as described by Robert Sailer, Assoc. M. ASCE, Head of the Bridges Section of the Bureau's Denver office, in his paper before the Structural Division at the Fall Meeting. Mr. Sailer's cost analysis is abstracted below. Presiding over the session was Craig P. Hazelet, M. ASCE, of Hazelet & Erdal, Louisville, Ky., Chairman of the Division's Executive Committee.

Another paper presented before the Division described the "Reconstruction of the White House," by W. E. Reynolds, M. ASCE, Commissioner of the Public Buildings Administration, from which the preceding article was prepared.

Timber testing was the theme of a paper by L. J. Markwardt, M. ASCE, Assistant Director, Forest Products Laboratory, Madison, Wis. in which the author pleads for "International Standardization of Timber Testing." An abstract appears below.

Robert Sailer

"Soap Lake Siphon, now under construction by the Bureau of Reclamation, is part of the West Canal of the Columbia Basin Project," Mr. Sailer explained to the Structural Division. Near Euphrata, Wash., 50 miles southwest of Grand Coulee Dam, the West Canal of the project, designed to carry 5,100 cfs, crosses the lower end of the Coulee in the vicinity of Soap Lake.

To determine the most economical location for the siphon, several possible structures and locations were considered. A pressure tunnel under Soap Lake was abandoned when rock was not found at a depth of 200 ft. Likewise a 3,000-ft rockfill across the lake, which is 30 ft deep, was considered impractical because the silty clay bottom was found to be capable

neither of supporting the fill nor of supplying frictional and lateral support for piles. Cost studies for lines around the south and north ends of Soap Lake resulted in the selection of the north alignment as least expensive—a route 2½ miles long, Mr. Sailer explained.

"These studies showed that twin pipes cost about 25 percent more than a single pipe. It was noted that the cost of the steel pipe at a 100-ft head was nearly double that of a concrete pipe." Further studies resulted in "the design of a monolithically constructed, steel-lined pipe," 22 ft in diameter with a reinforced concrete shell thickness of 21 in. The inside face of the pipe is a ¼-in. steel liner which provides a watertight membrane, an inside form, and serves as a part of the required steel reinforcement.

Alternate bids on steel pipe and steel-lined concrete pipe showed a saving of over 30 percent by using the newly designed steel-lined concrete construction. Further studies for this installation, Mr. Sailer revealed, showed steel-lined pipe to be more economical than concrete pipe for heads over 92 ft. On the final location, about 8,000 ft of 22-ft-dia steel-lined concrete pipe is beng constructed where the head is over 100 ft; for lower heads, 25-ft-dia concrete pipe is being used. The cost of the Soap Lake Siphon will be about $8,100,000.

L. J. Markwardt

"Considering the many thousands of wood species which comprise the timber resources of the world, the

Craig P. Hazelet, Chairman, Executive Committee, Structural Division; Hazelet & Erdal, Consulting Engineers, Louisville, Ky.

amount of research required to determine their properties is of a magnitude that could well engage the facilities of all agencies interested and working in this field," Mr. Markwardt told the Structural Division. "To make the combined efforts of all research agencies of greatest value," he said, standardized test procedures are being developed both nationally and internationally.

At present, in continental Europe, tests are made on small, clear specimens about 2×2 cm in cross section, but varying in size with each country and also with the purpose of the test. Test methods in use in Europe are basically different in many respects from those used in the United States, Canada and elsewhere, where the specimens measure 2×2 in., Mr. Markwardt pointed out.

Recognizing these differences in wood testing practices and in the evaluation of wood properties, conferences have been held looking toward standardization. One was held in England in 1937 under the auspices of the Timber Research Committee of the International Union of Forest Research Organizations; another in 1939 at the same place in England; and the third in Geneva, Switzerland, in 1948, under the auspices of the Food and Agricultural Organization of the United Nations through its Subcommittee on Mechanical Wood Technology.

Because of the great investment already made in equipment and in test results obtained by using existing standards, "international standardization has taken the normal direction of establishing agreement on broad principles of methods rather than the establishment of complete, detailed methods," Mr. Markwardt stated.

More Data Needed, Water Engineers Are Told

CLEAR WATER released from huge multi-purpose reservoirs, in picking up silt, may so change the regimen of rivers as to damage canal diversions, sewer outlets, bridge piers and other water-side structures, Carl B. Brown, Assoc. M. ASCE, Sedimentation Specialist, Office of Research, U.S. Soil Conservation Service, told the Hydraulics Division at its session on Thursday morning. In his paper, "Sedimentation Investigations: History, Status and Needs," he described how sediment blocks canals, diverts rivers and fills reservoirs. Irrigation engineers have been fighting sediment for centuries, he said. He pleaded for more research and more data on silt movement so that changes in river regimen can be predicted in advance and a basis provided for estimating the total future costs of multi-purpose valley development projects.

Traditionally Americans make plans for building before basic facts are available and then begin to build before the plans are done, Merrill Bernard, M. ASCE, Chief, Climatological and Hydrologic Services, U.S. Weather Bureau, told the Division at the same session. An exception to this rule is the practice of federal agencies which pool their needs for hydrological data and make a coordinated effort to obtain the necessary data. Mr. Bernard explained the procedure begun early in 1948 of accomplishing this by using punch cards and tabulating-machine methods.

As a result of two trips to the Middle East, the last in 1947–1948, A. L. Wathen, Director of Engineering, U.S. Bureau of Indian Affairs concludes that the full development of now unused water resources there could transform the area into an empire supported by agriculture at costs comparable to those of developing river valleys in the United States. Such development would lift the standard of living of an impoverished people. In his paper, "Water Resources of the Middle East," he briefed the plans and contemplated works to accomplish these objectives in Egypt, Iraq, Palestine and Arabia.

This Thursday morning session of the Hydraulics Division was presided over by Lorenz G. Straub, M. ASCE, Director of the St. Anthony Falls Hydraulic Laboratory at the University of Minnesota and Chairman of the Executive Committee of the Division.

Carl B. Brown

"For 6,000 years at least," Mr. Brown stated, "sediment has hampered the efforts of engineers to con-

trol and utilize the waters of the earth." In 4,000 B.C. hordes of slaves must have been employed to maintain the extensive network of irrigation canals in the valley of the Tigris and Euphrates Rivers which made of the plain of Babylonia a legendary Garden of Eden and the birthplace of irrigation engineering. Here at the head of the Persian Gulf, Ur of the Chaldees was a thriving seaport, he told the Hydraulics Division. This city today lies buried in the desert 150 miles from the present shore of the Gulf.

Speaking of harbor silting in this country, he said that of all the early ports on Chesapeake Bay, Baltimore alone prospered because it waged a constant battle against this menace. By 1831, the city had already spent $500,000 for harbor dredging. From 1836 to 1941 the federal government dredged over 111 million cu yd of silt from the harbor at a cost of nearly $17 million. At the present estimated rate of sediment inflow—about 600,000 cu yd annually—the government must spend annually the equivalent of nearly $0.50 per acre of watershed above the harbor to remove the product of soil erosion washed into the port's waters, Mr. Brown said.

Despite the antiquity of the sediment problem, it has been less than a hundred years since the first scientific efforts were made to understand the phenomena of sediment transportation by streams, or to measure the quantities of sediment transported, or to evaluate the effects of sediment on water use, the speaker said. The tremendous increase in river basin developments during the past 20 years has magnified the significance that must be attached to sediment.

The multi-billion-dollar river basin developments being constructed or authorized on alluvial streams such as the Missouri, Red, Arkansas, Rio Grande and their tributaries, will when constructed rather completely disrupt the present equilibrium between river flow and river bed, Mr. Brown declared. The river flow, normally laden with sediment, will issue from giant dams crystal clear. It will obtain from its bed and banks such loads as it can pick up and transport. Lowering of the bed may affect bridge piers, water intakes, sewer outlets, bank stabilization works and levee systems, he warned.

On the other hand, the bed load brought in by tributaries downstream from the reservoir may be too much for the regulated flow of the main river to move, Mr. Brown pointed out. The local channel plugs thus formed may accelerate flooding, cause bank erosion, and otherwise damage river valley developments. Channel aggradation above reservoirs will produce equally critical problems, he believes.

Lorenz G. Straub, Chairman, Executive Committee, Hydraulics Division; Director, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minn.

Means of predicting these changes in advance would at least give a basis for estimating what the total future cost of multi-purpose developments may be. This cost rather than merely the initial cost of the dams should be evaluated in terms of the project benefits, and perhaps against alternate plans or designs, the speaker said.

Administrators, legislators, engineers and conservationists alike need to be made aware of the implications of sediment in the short-term as well as the long-term efficiency, even in some cases in terms of the soundness, of projects included in the multi-billion-dollar river basin developments now under way, he said. His conclusion is that more data are needed on the whole problem of sediment, and also that there is a pressing need for the adequate analysis of existing data for immediate use.

Merrill Bernard

The water planner's idea of Utopia, Mr. Bernard told the Hydraulics Division, is a place where, for every point of planned or potential development, there is available a record of streamflow of sufficient length to include the physical extremes and embracing a sufficient number of observations to make it statistically significant. Lacking such records, he said, the planner has managed to overcome the deficiencies in available records by converting precipitation data to runoff by means of assumptions which are becoming more and more dependable as time passes.

It is the inclination of Americans to begin to build before the plans have cooled off, and to begin to plan before the basic facts are known, he pointed out. An exception to the traditional rule is the determination of federal agencies to pool their hydrologic data needs and to coordinate their efforts in acquiring such data. Evidence of this determination is the program of the Hydrologic Subcommittee of the Federal Inter-Agency River Basin Committee, the speaker said. During the calendar year 1948, the Subcommittee held field conferences at 14 points throughout the country, so selected that field representatives of the participating agencies could gather and confer with minimum travel expense. The Subcommittee consists of representatives from the Corps of Engineers, Bureau of Reclamation, Soil Conservation Service, Forest Service, Geological Survey, Public Health Service, Federal Power Commission, Bureau of Public Roads, Tennessee Valley Authority, and the Weather Bureau. The first conference, considered as a pilot project, was held in New York, January 14–16, 1948, and at it a technique was devised for systematically assembling field opinion as to the location of stations that should be added to the network in order to bring it up to adequate density for practical purposes.

Among the first tasks undertaken by the Subcommittee was the mapping of the nation-wide network of stations at which hydrologic observations are made. The network maps went far toward meeting the innumerable requirements of the participating agencies in the operation as well as planning of field projects.

A no less important purpose was served in revealing the deficiencies of the basic network. Great "open spaces" were brought to light. While the planning agencies were of course aware of these, they individually could do little to remedy the situation because of the highly interrelated agency interests involved, Mr. Bernard said.

"The trickiest problem facing the Subcommittee was the priority classification of stations recommended," Mr. Bernard stated. The importance of a projected station reflected not only the areal representativeness of the point at which the station was to be located, but also

the relative importance of the record to be taken there to the planning agencies that would use the data. Accordingly an equation was devised including these variables. Following the conferences, the recommendations were processed and summarized, using punched cards and modern machine methods to determine the number of each type of observation station required. Mr. Bernard continued:

"The density of a network of precipitation stations cannot be expressed as the average distance between stations or the area represented by the average station. The station record represents an experience at a point. In the Plains region and in a general storm of moderate proportions, the record at one point may compare closely with that at another point a considerable distance away. During showery conditions characteristic of the summer time, two stations quite close together may record widely differing amounts of rainfall. In mountainous country where the physiography of the region exerts the major control on climate, two stations within a few miles of each other may produce extreme differences in the precipitation record."

These factors and others were carefully considered by the Subcommittee in planning the expansion of its all-purpose network of hydrologic stations, the speaker said.

A. L. Wathen

"The most striking feature of the Middle East is that although it was the seat of the oldest civilization known," Mr. Wathen stated, "it is practically virgin territory in so far as modern development of its resources is concerned." He believes that the full development of resources now unused could transform a group of impoverished states into a great agricultural, industrial and commercial empire, and that the cost would be low compared to that of many river basin developments in the United States. The return on the investment in terms of a better standard of living for a large number of people would be very high.

In the Nile River basin of over a million square miles live 50 million people, 20 million of them in Egypt. Aswan Dam, 130 ft high; Gebel Aulia Dam, 20 ft high; and Sennar, 55 ft high, now provide flood protection for Egypt and irrigation water for 6 million acres in Egypt and one million acres in the Sudan.

Recent plans to construct dams at the outlets of Lakes Victoria and Tana would provide the key structures in a plan for complete control of the Nile, he said. With hydroelectric power, several thousand pumping plants are proposed to lift water extensively from canals, rivers and the underground basin to supply land now lying above the gravity canals and to keep groundwater levels down. The area susceptible to economic development under present and future conditions may exceed 12 million acres. This would result in doubling the present agricultural production and in raising the level of living of the people of Egypt, Sudan, Ethiopia and Uganda, stated Mr. Wathen.

CAMEL-POWERED pumping plant raises water from ancient spring for irrigation of Arabian date grove. Water in skin bucket is lifted by means of pulleys so as to discharge into ditch. Graph, prepared from data collected by author A. L. Wathen, shows capacity curve of pump per camel, per foot of lift.

In the Tigris-Emphrates Valley, legendary cradle of civilization, irrigation dates from prehistoric times. Some ancient canals were 400 ft wide and date back to 5000 B.C. Estimates of the ancient population run as high as 50 million, and the present population is 8 million, he said.

Full development of the Tigris and Euphrates Rivers by storage, principally in Turkey but also in Syria and Iraq, together with adequate drainage, would increase the present 5 million acres of irrigated land to not less than 10 million acres, he believes. Hydroelectric power could be generated for industrial use and for the manufacture of nitrogen base fertilizer. This development, according to Mr. Wathen, would improve the standard of living of the present population as well as provide a reasonable standard of living for an additional 20 to 30 million people.

The Litani River, draining the southern part of Lebanon and discharging into the Mediterranean near Tyre, supplies more water than can be beneficially used in Lebanon. Plans, which must have the approval of Lebanon, would divert surplus water to Palestine. The River Jordan also rises in southern Lebanon and flows through Lake Huleh and the Sea of Galilee to the Dead Sea. The latter is 1,286 ft below sea level. Plans for using the excess Litani and Jordan waters involve a dam on the Jordan at Jericho, and a pumping plant to lift Jordan water over the hills near Jerusalem. The program includes a 1,000-cfs canal from the Mediterranean into the Dead Sea for the generation of 85,000 kw of power from the 1,200-ft head thus made available. Full development of the irrigation and industrial potential of Palestine, according to Mr. Wathen, would provide for a reasonable standard of living for 5 million instead of a lower standard for the present 2 million people.

In Arabia, which supports a population estimated at 7 million, there are few places where surface storage is feasible. Control of flowing springs believed to be fed from a vast underground limestone strata 400 ft thick, 250 miles wide and 700 miles long, should be studied further to determine the feasibility of expanding irrigation there, Mr. Wathen stated.

Point IV Program to Lean Heavily on Private U.S. Engineering and Contracting Firms

From Address Before Construction Division at Washington, D.C., Fall Meeting

SAMUEL P. HAYES, JR.

Special Assistant to The Assistant Secretary of State for Economic Affairs, Washington, D.C.

AMERICAN ENGINEERS should be vitally interested in the increased emphasis in United States foreign policy on the importance of advancing the economic development of the underdeveloped areas of the world. It is inevitable that any such objective can be reached only through the widespread use of modern technical methods and the expansion of productive facilities.

Economic development in most countries in the past has been greatly assisted by the flow from other areas of technical knowledge, of capital, and oftentimes of population. New efforts are now being made to expand greatly the flow of technical knowledge to the underdeveloped areas and to encourage the process of overseas private capital investment.

Two Legislative Programs Presented

Two legislative programs aimed at the development of underdeveloped areas were submitted to Congress by the President on June 24, 1949. The first provides for an expanded program of technical assistance, and the second for experimentation with certain ways of encouraging the flow of private capital investment.

The methods of aiding economic development by providing technical assistance are numerous, including for example, the initiation of broad economic surveys; the provision of expert advisers and missions; the establishment of research centers, experimental centers and demonstration projects, and bilateral cooperative projects by governments (servicios) on specific problems; and the exchange of students, teachers and technical personnel.

Governmental organizations and private groups, both profit and nonprofit, have had considerable experience in disseminating technical know-how, particularly in Latin America. The widest possible use of these channels is envisaged under the Point IV Program. The United Nations and the many associated and independent international agencies will also carry on a major share of the work.

> "IN ORDER TO enable the United States, in cooperation with other countries, to assist the peoples of economically underdeveloped areas to raise their standards of living, I recommend the enactment of legislation to authorize an expanded program of technical assistance for such areas, and an experimental program for encouraging the outflow of private investment beneficial to their economic development." —*From President Truman's Recommendations to the 81st Congress*

The second aspect of the Point IV Program is the endeavor to stimulate private international capital investment by reducing certain non-business obstacles to investment abroad. It recognizes that private savings provide the main source of foreign investment capital. Private capital can contribute not only the funds but also the technical, managerial and organizational talents necessary for their effective use.

The program for fostering capital investment will not guard an investor against normal business risks. Supplemented by the bilateral commercial agreements being negotiated with other governments, however, the investment guarantee program may give the investor protection against non-business hazards such as inability to convert earnings and capital into dollars.

The two aspects are, of course, related. The technical cooperative assistance phase of the program will serve to stimulate investment by developing profitable investment opportunities, improving the stability of foreign governmental administration and fiscal management, and improving the health, education, and skills of the local populations.

The development program will lean heavily on private United States engineering and contracting firms. Hundreds of American and other engineers will go abroad annually to assist governments in developing their mining, transportation, sanitation, irrigation, aviation and other facilities. Since a shortage of available technical experts will seriously limit the scope of the program, it is hoped that American engineers will respond generously in making available their essential services under this program, both as individual members of technical teams and as contractors for technical services. The program moreover seems to presage a new scope of engineering activity and education in the United States.

It is anticipated that the program will be relatively inexpensive, particularly in proportion to its potential benefits. Exporting technical know-how may be a complicated process, but it is not a very expensive one. The increase in private foreign investment would, by definition, be outside the Government budget. A very great deal can be accomplished on a small outlay by the Government. This low cost is by no means an indicator of the force and significance of the Point IV Program, however.

Processes Have Cumulative Effect

The revolutionary magnitude of the program lies in the fact that the processes of technical cooperation and capital investment are cumulative in effect. As the program develops, more and more competent technical personnel will become available, more experience will be gained, and ways of disseminating information will be improved so that the technical cooperation aspects of the program will be expanded. The investment aspects can be expected to grow progressively after technical assistance has paved the way, and capital investment will produce more capital available for investment, both local and foreign. Thus, the judicious application of technical knowledge coupled with investment can bring about, gradually at first, and then with snowballing momentum, a revolutionary improvement in the material and social well-being of the world's peoples.

Technical Research Contributes to Progress in Construction Industry

CONTRIBUTIONS to technical research in the construction industry were discussed in two of the three papers presented at the Construction Division session at the Society's Fall Meeting in Washington, D.C. C. F.

Elmer K. Timby, Chairman, Executive Committee, Construction Division; Howard Needles, Tammen and Bergendoff, New York, N.Y.

Rassweiler, Vice-President, Research and Development, Johns-Manville Corp., spoke on "Technical Research in the Construction Industry," followed by Robert F. Legget, M. ASCE, Director of Building Research, Canadian National Research Council, Ottawa, Canada, whose subject was "Building Research in Canada." Mr. Legget's paper was discussed by Mason C. Prichard, M. ASCE, Assistant to the Chief, Military Construction Division, Corps of Engineers, U.S. Army, Washington, D.C.

The session was presided over by Elmer K. Timby, M. ASCE, Chairman of the Division's Executive Committee, of the firm of Howard, Needles, Tammen and Bergendoff, New York. The first speaker was Samuel P. Hayes, Jr., Special Assistant to the Assistant Secretary of State for Economic Affairs, who addressed the meeting on the "Point Four Program of the United States." His address is abstracted elsewhere in this issue.

C. F. Rassweiler

"Organized experimental work has a wonderful opportunity at the present time to contribute to the progress of the building industry and, through it, to the general well-being of the country," Mr. Rassweiler told members of the Construction Division. He discussed various difficulties which beset the conduct of research in the building field, enumerating four in particular—the difficulty of defining the objectives of such research, the difficulty of stimulating research in fields where it is lagging, the difficulty of evaluating new accomplishments, and the difficulty of securing prompt utilization even of well-authenticated advances in materials and techniques.

He spoke highly of the recently initiated Building Research Advisory Board, which has been constituted under the National Research Council and explained that the Board's activities are limited in two ways. First the Board is limited to those problems for which experimental research can offer a solution; and second, it is not organized to conduct research itself and can only stimulate and coordinate the research of other agencies.

After stating that the problem of stimulating and coordinating research in the construction industry is so great that no organization can do a complete job immediately, Mr. Rassweiler concluded by expressing the belief that the Building Research Advisory Board will become a major factor in helping the building industry achieve outstanding technical progress. His paper will be given more thorough treatment in a forthcoming issue.

Record Population Growth Creates Highway Problems in Washington Area

AN UNPRECEDENTED AVALANCHE of federal personnel, civil and military, has poured into Washington, D.C., since 1940. It has spilled over into Virginia and Maryland, creating there and in the District of Columbia needs for highway construction beyond the capacities of resident taxpayers alone to pay for.

In a symposium on the problem and its solution before the Highway Division, three speakers concluded that more federal aid is essential to help pay for the highway net needed to serve the federal city. The speakers were William F. Childs, Jr., Chief Engineer, Maryland State Roads Commission; C. S. Mullen, M. ASCE, Chief Engineer, Virginia Department of Highways; and S. R. Harrison, Deputy Director of Highways of the District of Columbia.

Harold G. Sours, Chairman, Executive Committee, Highway Division; Baldwin and Sours, Columbus, Ohio

More extended comments by these experts will be published in the next issue of CIVIL ENGINEERING in a symposium entitled, "Growing Population of Nation's Capital Creates Traffic Congestion in Adjoining Metropolitan Areas." Articles in this symposium will outline methods for meeting the present serious congestion in detail, each author discussing the situation as it relates to his particular area.

Presiding over the Division session was Harold G. Sours, Assoc. M. ASCE, chairman of the Division's Executive Committee, of Baldwin & Sours, Columbus, Ohio. The Commissioner of the Bureau of Public Roads, Thomas H. MacDonald, Hon. M. ASCE, presented a paper on the "National System of Interstate Highways"; and H. E. Hilts, Assoc. M. ASCE, Deputy Commissioner of the Bureau in charge of design, recently returned from Turkey, told the Division about his experiences in highway planning there.

Forty-Million-Dollar Suspension Bridge to Link Delaware and New Jersey

HOMER R. SEELY, M. ASCE

Project Engineer, Howard, Needles, Tammen & Bergendoff, Consulting Engineers, New York, N.Y.

THE DELAWARE MEMORIAL BRIDGE, now under construction across the Delaware River about two miles south of Wilmington, will connect Delaware's du Pont Highway with New Jersey's new Turnpike, now being planned. With its clear span of 2,150 ft, the structure will be the sixth longest suspension bridge in the world and will cost about $40 million. The project extends for a distance of 3½ miles, including the bridge length of 10,765 ft between abutments. Construction methods employed in the foundations of this structure are described in the following article.

MOST OF THE SITE of the Delaware Memorial Bridge is within the State of Delaware as the state line is the low-water mark on the New Jersey shore. Legislation passed by the State of New Jersey enables the entire project to be built, owned and maintained by the State of Delaware. An Act of Congress voted in July 1946 granted a franchise to the state for such construction, subject to the approval of the Secretaries of War and Navy, which was granted on March 15, 1947.

The permit stipulated that a horizontal clearance between fender lines of 2,000 ft, measured normal to the center line of the channel, must be provided, and an underclearance of 175 ft above mean high water for a channel width of 1,500 ft. Accordingly, the span length of 2,150 ft was fixed. (See Fig. 1.)

Bids were taken on January 6, 1948, for the construction of the tower piers and anchorage foundations for a six-lane structure. However, the award of such a contract was not possible because of a decision to postpone the issue of the bonds until a more favorable market existed. Also, considering the total bond issue of $40,000,000 which had been authorized, a reduction in the capacity of the bridge from six to four lanes was decided on.

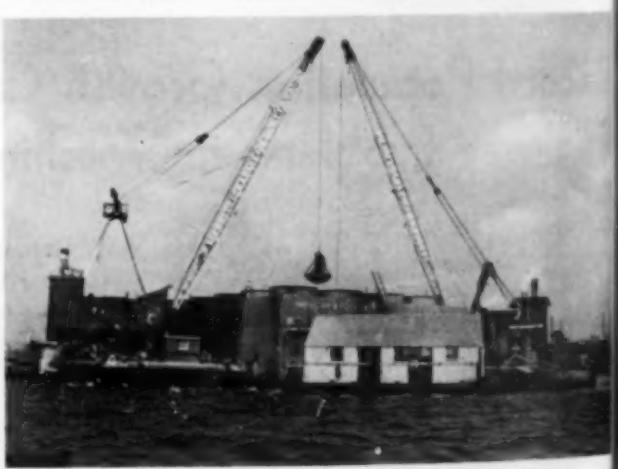
The bonds were issued on this basis in June 1948, and to date contracts have been entered into as listed in Table I.

The bridge project extends from New Castle Avenue, Del., to Shell Road, N.J., an over-all distance of 3½ miles. The State Highway Department with federal-aid funds plans to extend the Delaware approach westward as a limited-access highway to connect with the du Pont Highway. The New Jersey approach will connect directly with the New Jersey Turnpike, now in the planning stage. The toll booths and administration building will be located on the Delaware side just east of New Castle Avenue.

The tower piers and anchorage foundations will be founded at various depths on strata of hard clay or sand which, by means of tests on undisturbed samples taken from borings, were found to be capable of withstanding the design unit loads.

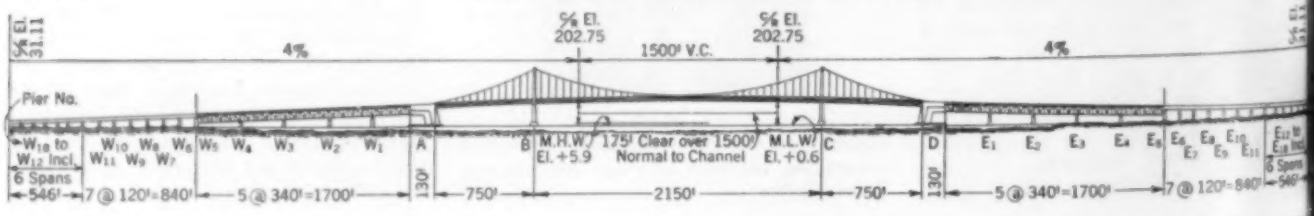
All four foundations were designed to be constructed by dredging in open caissons. However, on account of the short supply of plate steel for constructing the caissons, the contractor was given permission to construct the east anchorage foundation in a coffer-dam. The caisson for the west anchorage foundation is 95 ft 1 in. wide and 220 ft 10 in. long and is planned to be founded at El. −96 ft. The caissons for the tower piers are each 69 ft wide and 116 ft 10 in. long and are planned to be founded at El. −87 for the west pier and at El. −112 for the east pier.

The cutting edges for all three caissons were assembled at the New York Shipbuilding Plant at Camden, N.J. Welding was used entirely in assembling the cutting edges and extending the sides and interior bracing. The cutting edge for the west tower pier was floated on March 29 and placed in position on July 5. By October 1, a total of 7,118 cu yd of concrete had been placed in this caisson with the cutting edge at El. −83. The cutting edge for the east tower pier was floated on April 26 and placed in position on August 8. As of October 1, in all, 4,579 cu yd of concrete had been placed with the cutting



CLAMSHELLS (right) dredge caisson for east tower pier. Caisson, 69 ft wide by 116 ft 10 in. long, is to be founded at El. −112 on stratum of hard clay. This is considerably deeper than west tower pier, founded at El. −87.

FIG. 1. DELAWARE MEMORIAL BRIDGE (below) provides 2,000 ft of horizontal clearance between fender piles. Elevation of intersection of center line of cables and center line of tower is 442.17 ft. Elevation is drawn looking north.



DELAWARE MEMORIAL BRIDGE will have world's sixth longest suspended span of 2,150 ft Completed bridge, to cost $40,000,000, will carry four highway lanes over Delaware River near Wilmington, Del.

edge of the caisson at El. −59. The cutting edge for the west anchorage foundation was launched on April 28 and as of October 1 was still in Philadelphia having its sides extended preparatory to being towed to the anchorage location.

Temporary steel sheetpile sand islands 68 ft in diameter were constructed upstream and downstream from the tower pier sites and steel pile clusters were driven along the two remaining faces, to hold the caissons in position during sinking. For the anchorage caission, four sand islands 80 ft in diameter have been constructed.

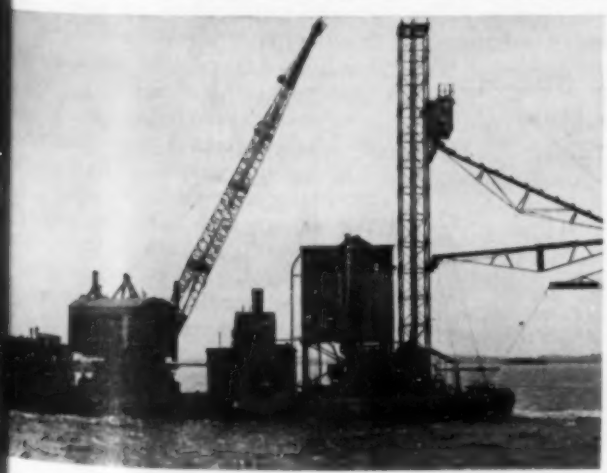
The cofferdam within which the east anchorage foundation is being constructed is 99 ft 2 in. wide and 225 ft 9 in. long. The 100-ft lengths of MZ 38 steel sheetpiling were driven to depths of from 77 to 84 ft. McKiernan Terry 10-B-3 hammers were used, and in some cases from 1,500 to 2,000 blows per ft were required to secure final penetrations.

In constructing the cofferdam the first operation was to predredge the area of the foundation to a depth of −40 ft. Then four units of welded structural steel bracing were assembled on barges floated one at a time to the site, and lowered by floating derricks into their proper positions, each unit being supported on six steel spud beams driven below the founding depth. Each unit of bracing provided transverse and longitudinal struts at Els. −41, −26.5, −11.5 and +8.0, spaced approximately 18 ft on centers with vertical posts at each intersection, braced diagonally with structural angles in the vertical planes in both directions. When the placing and driving of the sheeting were completed, the material within the cofferdam was dredged to the founding depth, which averaged −68.5 ft. Divers were used to check the removal of the soft disturbed material, which was accomplished with air lifts.

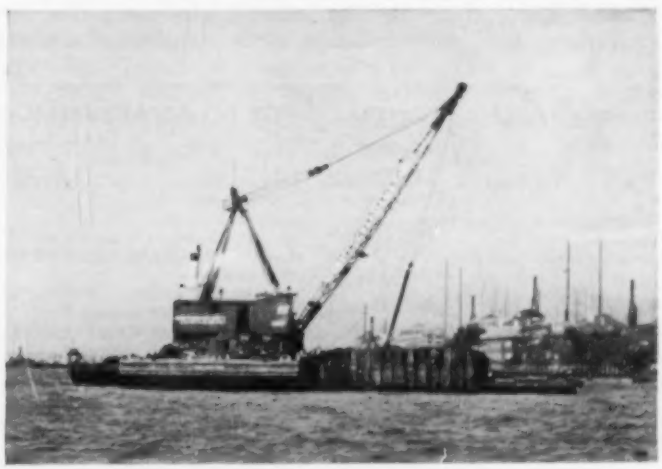
Tremie concrete was then placed throughout the bottom area of the cofferdam to a depth of 32 ft, being placed in four 8-ft lifts. The operation was carried on continuously starting about 8:30 a.m., Monday, August 15, and finishing about 6:15 p.m., Monday, August 27. Two floating concrete plants were used, one containing two 2-cu yd mixers, and the other, two 1-cu yd mixers. All concrete materials were batched in weighing hoppers directly over the mixers. The water within the cofferdam was pumped out after seven days, and the remainder of the foundation is now being constructed in open air. Construction was completed up to El. −22.5 as of October 1.

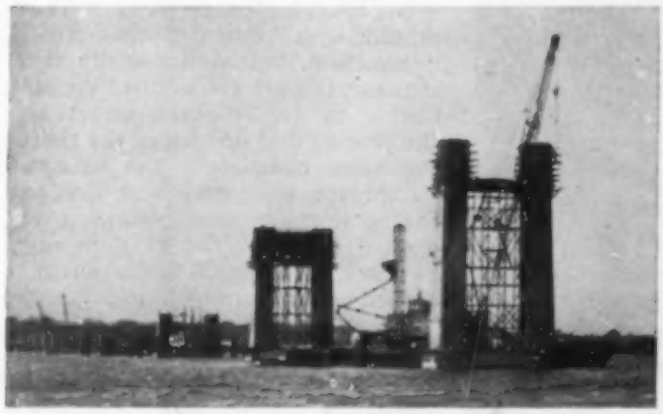
All the approach piers are founded on untreated timber piles, while the two abutments are on treated piles. Four of the approach piers on the Delaware side and two on the New Jersey side are located in the river, and the conventional steel sheetpile cofferdam construction was used for their foundations. The material within the cofferdams was dredged sufficiently to allow for the depositing of a 2-ft layer of sand over the mud bottom upon completion of the pile driving. The piles were fitted with

FLOATING CONCRETING PLANT containing two 2-cu yd mixers, places concrete in river piers and anchorages. Second floating concreting plant has two mixers of 1-cu yd capacity each. All materials are batched in weighing hoppers directly over mixers.



STEEL SHEETPILE COFFERDAM is used in construction of all river approach piers. All approach piers are founded on untreated timber piles, fitted with steel shoes and driven to practical refusal. Work on east river approach pier is shown here.





FORMS FOR RIVER PIERS on west, or Delaware approach are reused as top dimensions of piers are constant. Maximum height of any single pour is 16 ft. Spandrel forms are carried on two 26-in. I-beams supported by 14-in. 73-lb steel-pile sections embedded through pilasters.

TIMBER MATTING in foreground protects underground powe lines from falling objects. Photo taken on center line of structur looking west, shows piles being driven for east approach land pier and railroad siding used to haul materials. Siding will be left i place for use in steel erection.

steel shoes and were driven with McKiernan-Terry 10-B-3 underwater steam hammers. The specifications required all piles to be driven to "practical refusal," deemed to be such as would give a bearing capacity of at least 35 tons as determined by the Engineering News formula. Steel spud beams were used as leads for positioning and driving both batter and vertical piles.

After the bottoms of the cofferdams were sealed with a 5- to 6-ft layer of tremie concrete, the water within the cofferdams was pumped out, the piles cut off to grade, and the remainder of the pier bases constructed in open air. All concrete for the river work is distributed by chutes and deposited directly in the forms through elephant-trunks wherever the elevation of the pour permits. At higher elevations the concrete is hoisted in bottom-dump buckets. By October 1, the four pier bases on the Delaware side had been completed and the pier shafts were well advanced. On the New Jersey side, one cofferdam had been dewatered and the piles partially cut off to grade. The piling in the second cofferdam was substantially complete. Granite facing was embedded on the faces of the pier bases above El. −5 to withstand the erosion of tidal waters. The faces of the tower piers and anchorage foundations are protected in similar manner.

Specifications permitted the use of form lining for the river approach piers. Accordingly the contractor constructed his forms with $1\frac{1}{4}$-in. tongue-and-groove horizontal lagging, with $\frac{1}{8}$-in. Masonite lining placed with the smooth side against the forms. Studs 3×6 in., spaced approximately 1 ft 4 in. on centers, and wales made of two 3×6-in. timbers, spaced from 2 ft 0 in. to 3 ft 6 in. on centers, served to reinforce the lagging. Tyscrus form ties, $\frac{3}{4}$ in. in diameter, were placed between the wales at about 2-ft centers. As the top dimensions of the piers are constant, the shaft form units were reused on successive pours, working from the tallest to the shortest pier. The maximum height of any single pour was 16 ft. A 7-ft length of 14-in. 73-lb steel-pile section was embedded through the pilaster at the top of each shaft to support the two 26-in. I-beams used to carry the spandrel forms. The surface of the concrete was depressed adjacent to the embedded beams t permit patching of concrete after th projecting ends of the beams were burned off.

The land piers and abutment on the New Jersey side are all located in relatively stable ground. Accordingly the contractor elected to construct th footings in open excavations. The groundwater elevation was lowered by a series of well points surrounding areas containing several pier sites. Subsurface conditions in this area required jetting to assist in driving the piles. The procedure used was to first jet a hole about 30 ft deep at the location of the pile. Then the pile was positioned and driven, the jet being reinserted beside the pile and kept operating down to the 30-ft depth while the pile was being driven to its required bearing. Pile length generally varied from 55 to 65 ft. Vulcan No. 1 and Super Vulcan No. 50 C steam hammers were used to drive these piles.

Specifications for Land Pier Forms

The specifications provided that the forms for all land piers and abutments be constructed with dressed lumber with the boards placed vertically. Accordingly the contractor constructed his forms with 2 × 6-in. tongue-and-groove lagging reinforced with steel channel wales spaced from 2 to 3 ft on centers. The wales were made up of two 4-in. channels (5.4 lb per ft) placed back to back with 2-in. wood spacers between them. A 2×6-in. batten strip was bolted to the channels to bear against the lagging. Tyscrus form ties $\frac{3}{4}$ in. in diameter were placed between the wales on 2- to 3-ft centers. The maximum height of any single pour was 16 ft. The spandrel forms for the piers were carried on two 24-in. 76-

TABLE I. CONTRACTS FOR DELAWARE MEMORIAL BRIDGE

Contract	Contractor	Date	Estimated Cost
Tower piers and anchorage foundations	Merritt, Chapman & Scott Corp., New York, N.Y.	July '48	$11,494,586
West approach embankment	Citro & Sons, Inc.	Oct. '48	22,500
Approach river piers	Merritt, Chapman & Scott Corp.	Jan. '49	1,291,240
West approach land piers	Conduit & Foundation Corp., Philadelphia, Pa.	Jan. '49	609,520
East approach land piers	Lewis & Bowman, Inc., Norfolk, Va.	Jan. '49	709,650
Anchorage blocks	Merritt, Chapman & Scott Corp.	Jan. '49	1,830,000
Towers and suspended steelwork	American Bridge Co., Philadelphia, Pa.	Mar. '49	6,119,300
Cables and suspenders	American Bridge Co.	Mar. '49	2,311,985
Approach superstructure steelwork	American Bridge Co.	Mar. '49	5,299,805
Tower elevators	Otis Elevator Co., Philadelphia, Pa.	Sept. '49	32,985
East approach grading	Henry Eastburn & Son, Newark, Del.	Sept. '49	56,210
West approach grading	Henry Eastburn & Son	Sept. '49	134,101

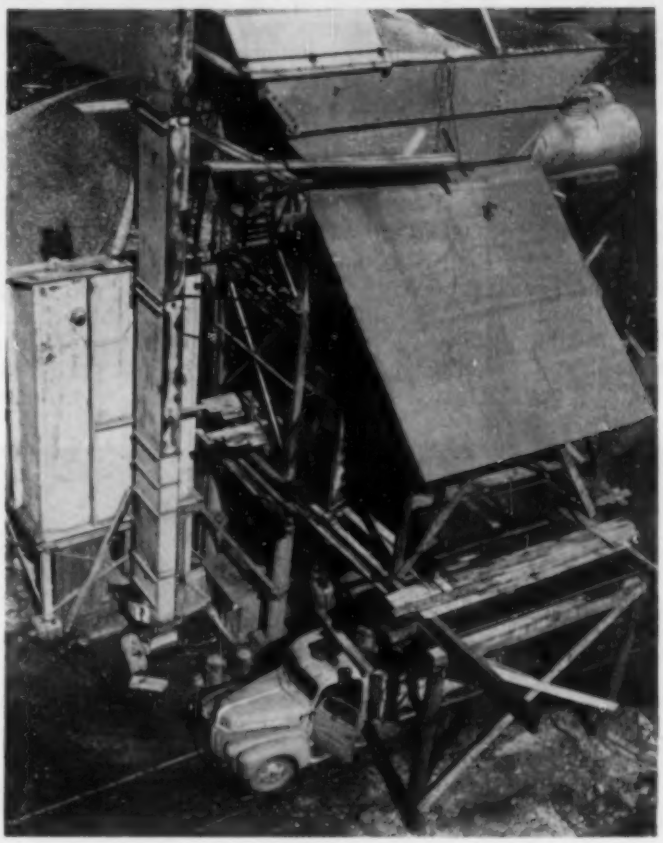
PILES are cut off (right) prior to placing layer of gravel over mud inside cofferdam for land pier foundations, Delaware approach. Piles vary in length from 40 to 70 ft.

beams which were supported at each end on braced timber pile bents resting directly on the pier footings.

The concrete for the land piers on the New Jersey side was mixed in a central mixing plant containing two 1-cu yd mixers with batching hoppers directly over the mixers. The mixers were mounted high enough to permit discharge of the concrete into bottom-dump buckets which were transported on flatcars to the site of the pour. The buckets were hoisted by a crane from the flat cars and emptied directly into the forms, using elephant-trunks where necessary. The railroad siding for this distribution system will be left in place for use by the contractor in erecting the steel superstructure. On October 1 eight piers were complete and the footings for another pier and the abutment were poured. Piling for two more piers was also well advanced, and three piers were yet to be started.

The land piers on the Delaware side are in a low swampy area over which a land fill was placed under another contract purely for access purposes. Simple cofferdams were constructed by driving 10-in. 42-lb H-beams 20 ft long vertically around the area of the footing. The H-beams were uniformly spaced and as the earth was excavated, timber panels were inserted between the flanges. One 12×12-in. timber wale placed at ground elevation generally sufficed to withstand the outside pressure although, on occasion, cross struts were placed to reinforce the wale and in some cases additional timber wales and struts were placed at the bottom of the excavation. The mud was sufficiently impervious so that practically no pumping of water was required. After the piles were driven, however, a layer of gravel was placed over the mud before concreting. Pile lengths varying from 40 to 70 ft were required and were driven with Vulcan No. 1 steam hammers.

The pier shafts were constructed with only three form units which were originally constructed for the tallest pier and progressively cut off on the bottom for the successively shorter piers. The shafts of Piers W6 to W12 were poured in two lifts and those of Piers W13 to W24 in one lift. The forms were constructed of 3-in. S.4.S. vertical lagging bolted with countersunk head bolts to steel wales spaced uniformly on 3-ft 2-in.



CENTRAL mixing plant (right) containing two 1-cu yd mixers supplied concrete for land piers on New Jersey shore. Mixers are mounted high enough to permit discharge of concrete into bottom-dump buckets which are transported on flat cars to pouring site.

centers. The wales were 8-in. WF 24-lb beams framed at each corner to overlap and to be bolted together. No internal form ties were used. The maximum height of pour was 29 ft 10 in. The spandrel forms were supported on welded steel trusses which were supported at each end on steel brackets bolted to inserts imbedded in the shafts on the inside face of the pilaster. All concrete for these piers was mixed at a central mixing plant in South Wilmington and delivered to the site in 5-cu yd trucks. Cranes hoisted the concrete in tip buckets for pouring in the shaft and spandrel forms.

As of October 1, four piers were entirely completed; the shafts and footings of eight other piers were completed; and all but two of the remaining piers were in varying stages of completion. The piling for the abutment was also substantially completed.

Cement for the concrete on all contracts is Type II A, being supplied in varying amounts by Alpha, Lehigh, Lone Star and Whitehall Cement Co. The concrete for the tremie seals of the approach-pier cofferdams contains $6\frac{1}{2}$ bags of cement per cu yd. The tremie concrete sealing the east-anchorage cofferdam contains 5 bags of cement per cu yd, and all other concrete contains 6 bags of cement per cu yd. All cement is shipped in bulk. For all river work the cement is unloaded from the cars and placed on barges at the Reading

(*Continued on page 90*)

Long Beach Naval Shipyard Endangered by Subsidence

Civil Engineer Corps Plans Protective Construction to Meet Progressive Sinking of Area

From Paper Presented Before Waterways Division at Washington, D.C., Fall Meeting

LEWIS C. COXE

Commander (CEC), U.S. Navy; Public Works Officer, Long Beach Naval Shipyard, Long Beach, Calif.

SUBSIDENCE OF the Wilmington oil field, the largest producing field in California, located 20 miles south of Los Angeles and encompassing the harbor districts of Los Angeles and Long Beach, has reached the astonishing total of more than 9 ft since 1937. Discovered in 1932, the first producing well in the field was completed in December 1936. Now over 2,000 wells, operated by 130 companies or individual owners, remove in excess of 45,000,000 bbl of oil yearly. More than 64,000,000 cu ft of natural gas is removed daily.

In 1940 the Navy began construction of a large shipyard on Terminal Island, at the southerly limit of the field. Work on this installation was rapidly completed, and in February 1943 the Long Beach Naval Shipyard was commissioned. By agreement with the city, original title holder of the land, the Navy relinquished all mineral rights in the taking of the land. At the present time, some 67 wells are slant-drilled under the shipyard from locations just outside its north and east boundaries.

U.S. Geological Survey levels run in 1940, three years after the Wilmington Field began production, showed very definite subsidence trends. No particular alarm was felt at that time, as the magnitude and extent of the later subsidence were not yet apparent. However, by 1945 it was obvious that something unusual was occurring. A saucer-shaped subsidence pattern with a maximum sinkage of 4.5 ft at the center was determined by wide area surveying. It was also determined that the center of subsidence coincided closely with the center of production of the field. Contours of subsidence showed an elliptically shaped depression roughly 12 sq miles in area, with its center some 2,000 ft northeast of the shipyard.

Long-Time Subsidence Studies

Studies of the causes and effects of subsidence have been made by engineers, geologists, and petroleum men for the past five years. The Navy Department, through the Bureau of Yards and Docks, initiated a full-scale investigation in 1945, with F. R. Harris, Inc., of New York, making the study and preparing the report. About the same time, the Long Beach Harbor Board engaged Drs. James Gilluly, U.S. Grant IV, and Harry Johnson to study and report on the situation. Though the two studies were made independently, both agreed that the major cause of subsidence was the removal of oil and gas from the field. Both reports estimated a total subsidence of from 8 to 10 ft at the center.

Early in 1948, it became apparent that subsidence would exceed the estimates made in the 1945 reports, the rate having increased to nearly 2 ft per year. The Bureau of Yards and Docks again studied the problem, with the advice of government and private technical experts. A Joint Committee set up by the Long Beach Harbor Board, reporting in 1948, recommended a study of water repressuring of oil zones as a means of

REMOVAL OF OIL AND GAS from California's Wilmington Oil Field is blamed for 9-ft sinkage of ground surface. Studies estimate total subsidence in future may reach more than 21 ft. Subsidence below high-tide level of Navy Shipyard drydocks and piers, Edison Co. steam plant, and major industrial plants on Terminal Island, requires immediate protective construction while studies proceed to find ways to retard or stop progressive lowering of ground levels.

secondary oil recovery and a possible means of stopping or checking subsidence. The Stanford Research Institute of Palo Alto, investigating subsidence for a large number of local interests, published a report in July 1949. These studies, though inconclusive, tend to bear out the contentions of previous reports that compaction in the oil zones due to pressure reduction incident to the removal of oil and gas, is the primary cause of subsidence.

One of the results of the 1948 study was the realization that some degree of subsidence is by no means unusual in oil fields. Survey data for the Los Angeles Basin showed subsidence of from 2 to 4 ft at the Inglewood Field, Huntington Beach Field, Dominguez Field, Signal Hill Field, Santa Fe Springs Field, Playa del Rey Field, and Rosecrans Field. Subsidence of the Goose Creek Oil and Gas Field in Texas in 1927, has been reported and attributed to removal of oil and gas from underlying strata. Subsidence of 14 to 16 ft has recently occurred in the Lagunillas Field, Lake Maracaibo, Venezuela, and to a lesser degree at the nearby Tia Juana Field.

Important Industries Threatened

Three factors distinguish subsidence at the Wilmington Field and set it apart from the other examples mentioned. These factors are: (1) The magnitude of the subsidence; (2) the magnitude of invested capital lying within the subsiding area; and (3) the danger of destruction or serious damage to industries and harbor facilities due to inundation by the sea. It has been conservatively estimated that capital investments within the subsidence area aggregate over $500,000,000, of which the Long Beach Naval Shipyard represents roughly one-fifth. Millions of dollars are invested in the harbor facilities of both Los Angeles and Long Beach; in the Southern California Edison Plant, largest electric power installation in Southern California; in the Ford Motor assembly plant, the Craig Shipyard, Proctor and Gamble, and many similar industries. Considerable effort has already been made to protect these industries from inundation by throwing up earth dikes, building concrete walls, and raising ground elevations. At least $30,000,000 worth of remedial construction will be required if subsidence continues unchecked. On the other hand, if remedial measures are not taken, the subsidence may cause a severe economic loss should the industries and activities in the area see fit to move to firmer ground.

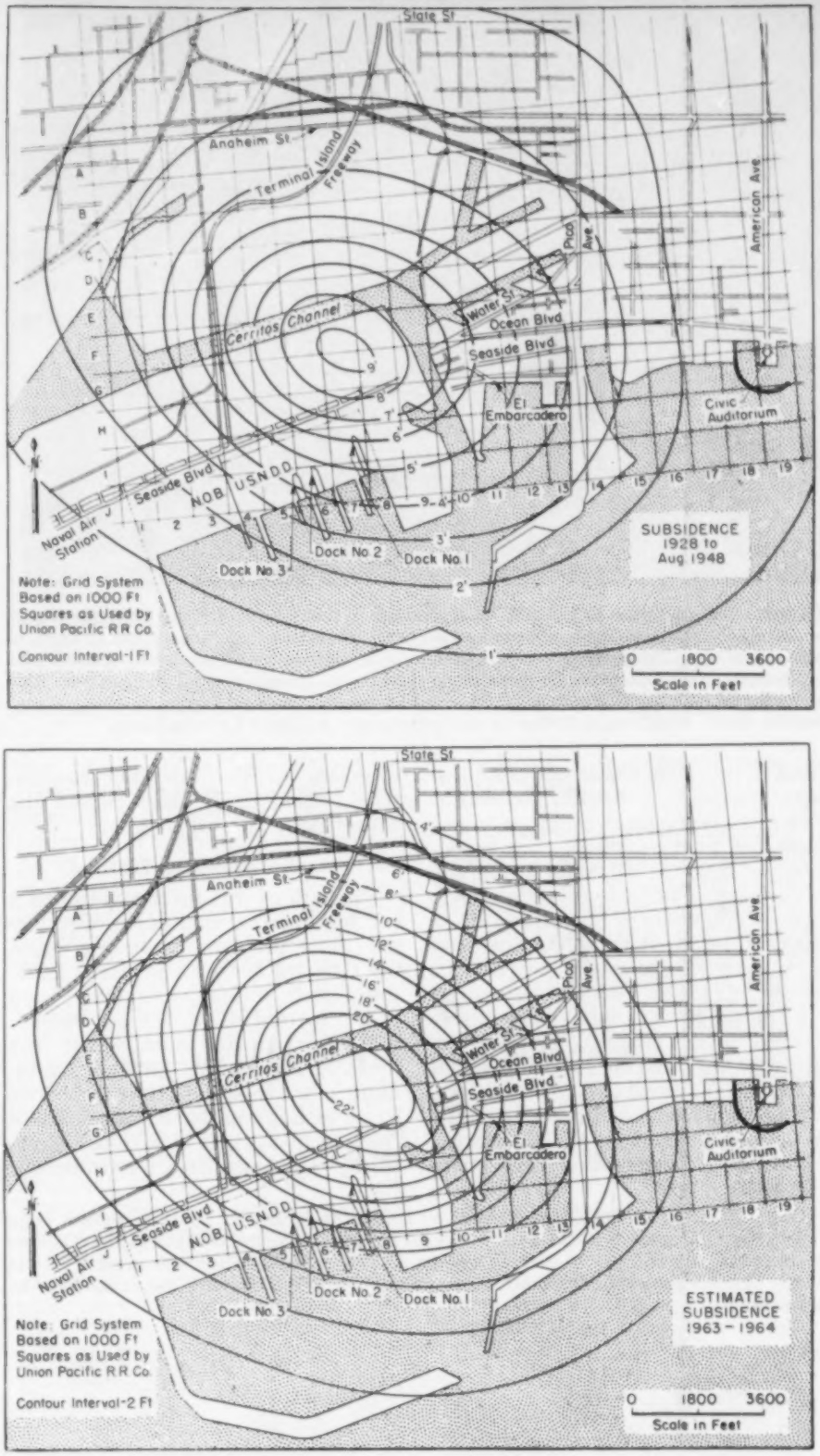


FIG. 1. **MEASURED SUBSIDENCE of Wilmington Oil Field to August 1945 (top) can be compared to total subsidence by 1963–1964 (immediately above), as estimated by Frederick R. Harris, Inc., consulting engineers to Bureau of Yards and Docks.**

When the field was first developed, oil pressures in the various zones were approximately hydrostatic, or equal to the pressure of a column of sea water extending from the particular zone to mean sea level. Usually natural water from the edges of a field infiltrate into the oil zones to replace the oil and gas as they are removed, thus maintaining reservoir pressures. However, because of the presence of many impervious faults in the Wilmington field, and possibly because of tarry deposits at the edges of the oil zones, very little infiltration or "edge-water encroachment" takes place there. Consequently, pressures in the oil zones have been reduced considerably by the removal of oil and gas.

Actual measurements of "bottom-hole pressures" in oil wells show reductions as great as 4,800 ft of water

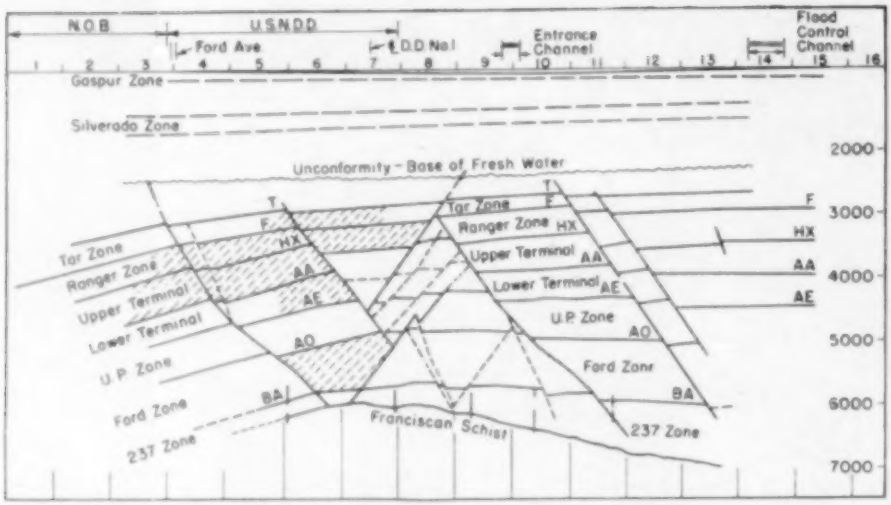


FIG. 2. GEOLOGIC CROSS SECTION through Wilmington Oil Field indicates site is underlain by alternate layers of sand and shale which rest on Franciscan schist at depth of about 7,000 ft. Structure is gentle anticline with axis northwest-southeast, divided into separate blocks or reservoirs by many impervious faults. Removal of oil and gas from zone at depths ranging from 2,300 to 6,500 ft has been more rapid than infiltration of edge water to replace them. Resulting reduction in oil-zone pressure is blamed for subsidence.

head in one zone whose original pressure was roughly 5,300 ft of water. Pressure reductions in other zones have not been as drastic, but reductions of 2,000 ft of water head, the equivalent of 880 psi, are rather average. Reductions of pressure of these magnitudes in oil zones, confined top and bottom between impervious layers of shale, produce stress increases on the granular materials in the oil zones, resulting in grain rearrangements and elastic compression of the granular materials themselves. Tests on oil sand cores taken from the Wilmington Field by F. R. Harris, Grant and others, show that stress increases in the amounts encountered, could easily have caused the subsidence observed to date.

Increased Subsidence Expected

Predictions of future subsidence call for a careful evaluation of probable future pressure drawdown, possible time lag between pressure drawdown and surface subsidence, and other factors of a similar nature. Estimates prepared in the 1949 Report by F. R. Harris, Inc., indicate a minimum subsidence of 14 ft at the center by 1963, but a probable subsidence of from 18 to 23 ft by that date. Practically all investigators now believe that ultimate subsidence will reach at least 15 to 16 ft.

In addition to vertical movements, horizontal motions of 2 to 3 ft have been observed. These movements are largely radial towards the center of subsidence. Some tangential motion has been observed which reportedly has rotated the main steam-power-plant building of the Southern California Edison Co. through an arc of approximately 1′ 20″.

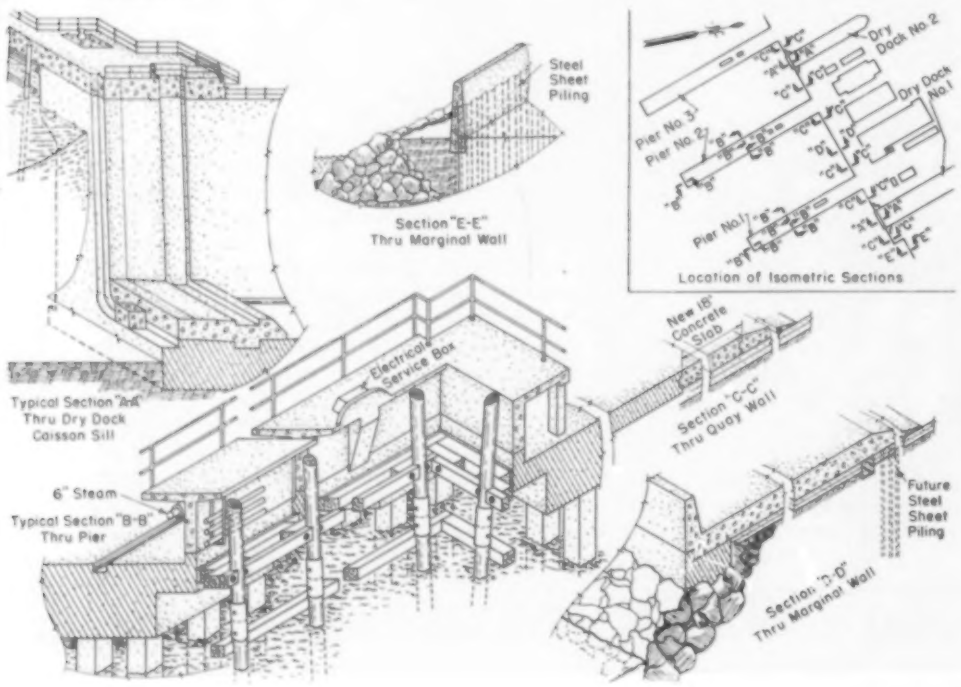
Two steps have been proposed by the Bureau of Yards and Docks to stop or check subsidence. The first is a voluntary reduction in the present rate of oil removal of about 30 percent; the second is the installation of a water repressuring system to maintain reservoir pressures in the oil zones.

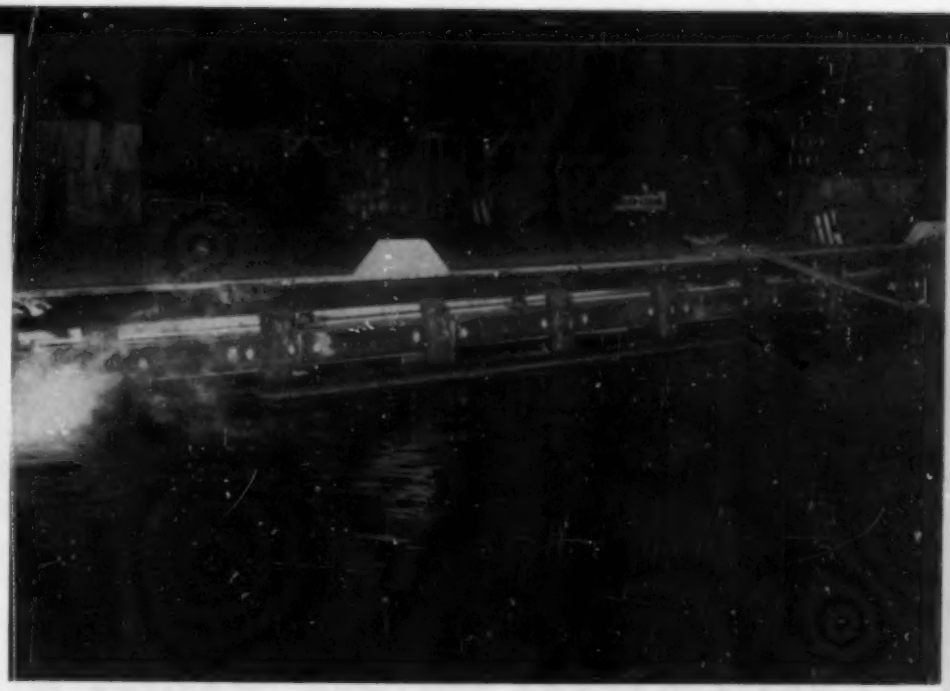
During a strike of oil refinery workers in September of 1948, production of oil from the Wilmington Field was reduced approximately 20 percent. In this period a very decided reduction occurred in the rate of subsidence within the naval shipyard. Although it is not possible to state definitely that this was a "cause-and-effect" action, the situation does seem significant enough to warrant further investigation.

Water repressuring or pumping of water into oil zones through carefully selected wells has been successfully used as a secondary means of oil recovery. However, this method has never been used to stop subsidence. Consequently there is no precedent upon which to base any hopes, although water repressuring, at least from a theoretical viewpoint, has possibilities of stopping subsidence. No other scheme has been presented to date. Also, additional oil recovered under a water repressuring operation would make the program attractive to oil producers. There are many technical problems involved, but their solution is possible by further laboratory and field tests.

The legal problems involved are also complex. "Unitization," or a pooling of interests of all producers in the field to insure equitable distribution of oil removed under the water repressuring program, would be necessary. The difficulties of obtaining agreement to such a program on a voluntary basis are manifold, and in the long run it may be necessary for the State Legislature to enact a compulsory unitization law. The importance of the problem and the serious consequences of unchecked subsidence make a thorough consideration of this program mandatory. Each foot of future subsidence represents possibly a million or more dollars in remedial costs.

FIG. 3. FIVE-YEAR PROGRAM planned by Bureau of Yards and Docks to protect Long Beach Naval Shipyard against inundation by sea includes protective wall and platform around piers, raising sills of drydock caissons, and building concrete dike along waterfront of yard in yearly increments as subsidence continues. Fund of $1,500,000 for first year's construction is available.





WATER AT HIGH TIDE stands 31½ in. below pier deck in recent view at Long Beach Naval Shipyard. Since maximum high tide is 10 in. higher than tide shown, and since subsidence averages 2 in. per month, pier installations are rapidly approaching inundation. Protective dike wall planned for this location (west side of Pier No. 1) is shown in Section C-C of accompanying Fig. 3.

Unless immediate measures are taken to protect the shipyard from inundation, it will be completely flooded at high tide within the next six to seven years. Flooding at high tide will commence in the lower eastern portions of the yard in 1951 and will progress gradually westward as subsidence continues. At the present time, the inboard end of Drydock No. 1, which is 1,100 ft long, is several inches below high tide. Until recently, when pump pits were installed, certain areas were flooded by sea water backing up storm drains during high tides. Steam lines under the piers were flooded so frequently that it has already been necessary to raise them to deck level. The drydock caissons, which close out the sea from the drydocks, already have been altered in order to permit proper seating at high tides. Along the waterfront, east of Pier No. 2, less than 30 in. of freeboard remains.

The cost of building the shipyard was $65,000,000 at 1943 prices. To duplicate it today would cost in excess of $110,000,000. Roughly, half of the value of the shipyard is in its waterfront facilities—its drydocks, piers, quaywalls, and underground services. The buildings within the yard, totaling over $13,000,000, would represent little net salvageable value. Little more than one-fifth of the value of the shipyard could be saved if the site were abandoned to the sea. Consequently the first premise in approaching the problem of subsidence was that abandonment of the shipyard was unwise and uneconomical and that protective measures must be taken. Remedial construction is planned to take care of the probable subsidence of 21 ft, with some factor of safety if subsidence exceeds this figure. At the same time, construction must be economical and planned to avoid serious interference with the work of the shipyard.

Waterfront Protected by Concrete Walls

The program of remedial construction is designed around the three major waterfront facilities of the shipyard—namely, the piers, the drydocks, and the quaywall. All of these structures lie along the south, or harbor boundary of the shipyard. The east boundary will be protected by raising the level of the Long Beach Harbor Board's Wharf "E" by earthfill. This work has already been started by the Harbor Board. The north boundary will be protected by earth dikes already installed by others around the north and northeast periphery of Terminal Island, and connecting in to Wharf "E." In addition, the center-line elevation of the 100-ft-wide Seaside Boulevard must be raised and maintained above high tide to form a second dike to protect the yard in case of failure of a portion of the periphery dikes. The west boundary is protected by the Naval Receiving Station, which to date has not suffered severely from subsidence.

No interference can be permitted in the operation of the giant 25- and 50-ton portal cranes on 30-ft gage rails that run along each side of the piers and around the drydocks. Consequently, a relatively thin-walled concrete dike is planned. This structure will be continuous from the eastern boundary of the yard westerly to Pier 6, enclosing the piers themselves. The drydock caissons form a portion of this wall. The dike walls are simple upright sections in some areas, while near the piers and drydock entrances, they support a 5-ft 10-in.-wide platform. The height of the wall varies from 6 ft 4 in. at the eastern end to 4 ft 0 in. at Pier No. 3, which will constitute the end of the first year's program. At each pier connection, the dike wall joins the wall around the pier. The pier dike-wall section is T-shaped, supporting a 6-ft 4-in.-wide platform for use in handling ship lines. All bollards and cleats used for securing ships will be raised to the platform level. In addition, outlets for steam, electricity, fresh water, salt water, oxygen, acetylene and telephones will be located at the platform level. All utility pipes, now located under the piers, will be relocated under the new platform. Only the electric installation of lead-covered cables will remain in its present duct system under the pier deck.

Pier Decks Must Be Watertight

Decks of the existing piers, 26-in.-thick concrete slabs, must be made watertight, particularly at the existing expansion joints and at storm-water drainage points. Under maximum subsidence conditions, the uplift on the bottom of the pier deck will not exceed the dead weight of the structure. Existing fender systems will be extended to protect the new wall structure from damage from ships moored alongside.

The existing quaywall structure between piers consists of a pile-supported concrete deck 57 ft 6 in. wide and 14 in. thick. To prevent infiltration of sea water behind this slab, a 12-ft-wide slab will be added. In addition, a steel sheetpile cutoff wall will be driven along the inboard edge of this new slab. Careful detailing will insure watertightness of the entire installation, particularly the horizontal and vertical expansion joints in pier decks, slabs and walls.

The seat for the caissons of Drydock No. 1 will be raised by 6 ft, and for the caissons of Drydocks Nos. 2 and 3, by 4 ft 6 in. Each dock is provided with two seats for caissons and, by using the outer seat, modifications can be made in the dry to the sill of the outer seat and to the complete inner seat. Precast concrete blocks will be bolted on the outer seat by divers after the other work is completed to form the new outer caisson seat. At the ground level, the approach capstans will be raised to the

(*Continued on page 90*)

FIRST-STAGE CONSTRUCTION on Clark Hill Dam on Savannah River, Georgia, project of Corps of Engineers, includes pouring of west spillway end of concrete gravity structure. In addition to purposes of flood control and navigation, 280,000 kw of power will be generated in seven units at normal operating head of 130 ft. Cost is estimated at $76,000,000.

Government Hydro Power Plant Construction

Takes Important Place in Work of Corps of Engineers, U.S. Army

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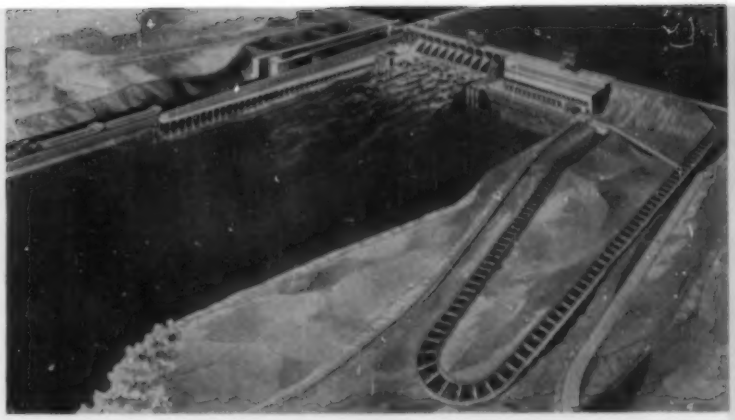
CONGRESS ADDED to the duties of the Corps of Engineers as early as 1913 the study of developing and utilizing water power for industrial and commercial uses as an extension of its river control work. It authorized the Corps to construct its first hydroelectric project, Wilson Dam on the Tennessee River, in 1918. In 1927 it authorized the Corps to survey and prepare reports on the feasible water-power resources of every navigable stream in the country. At this date Army engineers have built, have under construction or have authorized nearly 9 million kw of plant capacity as adjuncts to navigation and flood control projects. In this article, based on his paper presented before the Power Division in Washington, D.C., the author presents the broad policies of the Army engineers in determining the economic feasibility of its large multiple-purpose hydroelectric power projects, some of them estimated to cost upward of a quarter billion dollars.

THE FIRST step taken to assert the paramount interest of the United States in the potential water power of navigable streams was the passage of the Federal Water Power Act by Congress in 1920. In 1925 an act was passed instructing the Secretary of War, who at that time was also chairman of the Federal Power Commission, to prepare and submit to Congress an estimate of the cost of making surveys of those navigable streams whereon power development appeared feasible and practicable, with a view to formulating plans for the improvement of such streams for navigation, water power, control of floods, and the needs of irrigation. In compliance with this directive, the Secretary of War, in April 1926, transmitted to Congress a letter from the Chief of Engineers, which was printed as Document 308, 69th Congress, 1st Session.

This letter listed all the navigable streams upon which water-power development appeared to be feasible and the estimate of cost of examination of these streams. In 1927, Congress authorized surveys of the streams enumerated, now known as the 308 Surveys, and the Corps of Engineers then began the comprehensive study of the water-power resources and possibilities of the entire United States, known as the 308 Reports, which have since become the fundamental outline governing the selection of river basins and location of dams and reservoirs on these rivers for multiple-purpose developments. The development of the Tennessee River by the TVA has followed almost exactly the general scheme laid out in the 308 Report prepared by the Corps of Engineers for that river.

As the improvement of river basins has been undertaken, the original 308 Reports have been amplified by more extensive review reports. The main difference in the river development programs being adopted today and those first outlined is the increase in reservoir capacities and total increase in regulated stream flow, which will be accomplished by the construction of larger and more extensive systems of reservoirs. When the Bonneville and Grand Coulee Dams were designed and built, general information as to the probable ultimate development of the Columbia Basin was relatively meager. If the prospects for storage of more than 37,000,000 acre-ft above Grand Coulee, and more than 50,000,000 acre-ft above Bonneville, which are foreseeable today, could have been anticipated then, there is no doubt that provision for greater ultimate capacity would have been made at both projects. The storage now anticipated will make possible a regulated flow of about 85,000 cfs at Grand Coulee, and about 120,000 cfs at Bonneville.

Under the 308 general directive, information on possible power developments at Bonneville and Grand Coulee had been assembled before the country entered the depression period of the early 1930's, and those projects were undertaken as part of the public works program. In retrospect, the construction of these developments at that time was most fortunate, as they were built at a cost of about half the present contract prices, and they made available for war production about 1,400,000 kw of power at a high load factor and a low cost. At the Fort Peck Dam on the Missouri River in eastern Mon-



PLANS ARE in preparation for Ice Harbor Dam, and construction will begin upon appropriation of funds by Congress. This dam is one of four to provide slack-water navigation on Snake River from its mouth to Lewiston, Idaho. Features include lock of 100-ft lift, large fish ladder on each side of river, spillway capable of passing 680,000 cfs, and powerhouse with generating capacity of 325,000 kw at normal operating head of 98 ft. Initial installation is estimated to cost $89,458,000.

tana, built to furnish improvement to navigation, with incidental flood-control, power and irrigation benefits, the installation of power was begun during the war, and with the completion of present plans the plant will have a capacity of 85,000 kw.

Flood Control, a Federal Responsibility

In 1936 Congress for the first time recognized flood control as primarily a federal responsibility and since that time, the various river and harbor acts and flood control legislation have greatly increased the number of multiple-purpose projects to be undertaken by the Corps of Engineers at which water power can be economically developed as one of the objectives.

Since then the ultimate capacity of the projects built, under construction, and authorized, under the jurisdiction of the Corps amounts to about 8,800,000 kw, which is equal to about half of all the present developed hydro capacity in the United States. It is estimated that there remains nearly 60,000,000 kw at a 50-percent load factor that can be economically developed, and it therefore appears that, with the cost of alternative sources of power advancing rather rapidly with the increase in the cost of fuel, the prospects of continuing occupation for hydro-power engineers are favorable.

Multiple-purpose projects involving flood control and power are quite different from those that include navigation and power. The characteristic features that are found in the former type of projects usually include a fairly high dam, with a relatively large reservoir, a portion of the capacity of which can be made available for power storage. This permits the power development to be operated on a seasonal basis, with the drawdown of the power pool starting with the low stream-flow period in the fall and continuing throughout the winter, and refill taking place during the spring high runoff period. In many power systems, the power demand drops off during the spring and summer, and rises to a peak in the winter. In regions where air-conditioning has become an important part of the system load, the annual peak now occurs in summer. Seasonal operation of the reservoir and power plant makes it possible to contribute additional hydro capacity to the system just when it is most needed.

There are two decisions that are required in the early planning stage of a flood control and power project. The first is the height of the dam. The topography at the dam site may settle this question, or it may be decided by the limit set by the relative location of upstream villages or towns, railroads, or main highways. Since the number of available sites for flood control dams is limited, it is desirable that the greatest feasible development of this important national resource be planned. In many cases, restrictions mentioned above prevent the maximum development. The basic requirement is this—the total annual benefits of the project must exceed the annual charges.

The second decision to be made is the division between the flood control pool and the power pool. To a certain extent flood control has priority over power, both because the law states that the generation of power is incidental to other purposes and because flood control can be effectively secured in many cases only from the retention of flood waters in reservoirs, while an alternate source of power is always available at fuel-burning generating stations. Therefore, the first allocation of reservoir capacity is set by the requirements for flood control. A study of the hydrology of this and adjacent drainage areas shows the magnitude of floods of record. The objective is to provide protection against a flood that it is reasonable to expect during the life of the project. Any storage remaining over that found economically justifiable for control is available for power use.

The conditions at this type of project are ideal for operating such projects as peak-load plants in a system in which the base load is carried on steam. With full control of the draft of water, the load on a station can be rapidly increased from no load to full load or as rapidly decreased, according to the requirements of the market, the only stipulation being that the discharge from the plant shall not be increased so suddenly as to send objectionable bores or waves down the river channel. The ease and rapidity with which a power unit can be put on the line as compared to a steam unit makes the hydro plant not only useful in picking up the daily peak loads, but also most desirable as a reserve for emergency operation when a steam unit or power line drops its load because of system disturbance.

For moderate and high heads, the incremental cost of adding a unit to a hydroelectric plant is usually less than the cost of the same capacity in a steam unit, and for that reason it is often economical to add some hydro capacity for extreme peak or standby operation even though it turns out only a few kilowatt-hours per year.

Solution of the problem of optimum drawdown requires some careful figuring. The lower the water is drawn, the larger the regulated flow; but as the head is reduced the turbine capacity is also reduced approximately as the three-halves power of the head, and a point is soon reached at which the full-gate output of the turbine is less than the rated capacity of the generator, and the dependable capability of the plant becomes less than the rated capacity. If, to keep up the dependable capability, a larger than normal turbine is selected, the water passages and power house must also be enlarged, and the added cost soon offsets the value of the increase in capability. A compromise must be arrived at, with the drawdown established at a level somewhat higher than at the theoretical figure which would furnish the largest primary power.

Power Available at Navigation Dams

Dams that combine navigation locks and power are typical run-of-river developments, with no storage, and a very limited amount of pondage that may permit a small carry-over of stream flow during week ends. Many low-lift navigation dams are not suitable for power installation, because during floods the upper pool is maintained as near as possible at

the normal elevation, while the lower pool level continues to rise with the increase in river flow until the difference in water levels becomes so small that a turbine could not maintain its rotative speed, and the power capability would be reduced to zero. In recent years the Corps of Engineers has developed single-lift locks and navigation dams high enough to maintain, even in high water, a considerable part of the difference in level between upper and lower pool, and the installation of power at these dams has become economically feasible.

High Power Output at Bonneville

Largest of these combined navigation and power developments now in operation is the Bonneville project, located on the Columbia River, about 35 miles east of Portland, Ore., which has a normal operating head of about 60 ft and an installed capacity of 518,400 kw. During the flood of June 1948, when the discharge of the river was the second highest on record, about 1,000,000 cfs, with the gross head reduced to about 26 ft, and with some additional loss at the racks due to an accumulation of drift, the plant continued to turn out from 175,000 to 200,000 kw.

The McNary combined navigation and power project, on the Columbia River below the mouth of the Snake, will have a normal operating head of about 82 ft, and the plant is designed to accommodate 14 units rated at 70,000 kw each, or a total of 980,000 kw. At a flood flow of 800,000 cfs the head will be reduced to 62 ft, but, owing to larger permissible gate openings at the lower head, the output of the plant will be cut back only to about 900,000 kw.

Four navigation and power dams are being designed to provide slackwater navigation on the Snake River from its mouth to the City of Lewiston, Idaho, among them the Ice Harbor Dam, here illustrated. These dams will have operating heads varying from 82 to 100 ft, and will ultimately have capacities of from 275,000 to 325,000 kw each. At maximum floods these heads will be reduced about 10 to 20 ft. All six of these dams in the Columbia River Basin are equipped with adjustable-blade propeller-type turbines, which are able to maintain high efficiencies over a wide range of heads.

Run-of-river plants at navigation dams, with large flows and very little pondage, usually operate on the base load of the system, generating power 24 hours a day. If the pondage is large enough to permit operation on a load factor, care must be taken to see that fluctuations in river levels that would take place below the dams, and the variations in river velocities, are not great enough to become objectionable to navigation interests.

Power plants located at flood control reservoirs, when interconnected with power plants located at navigation dams in the same power system, can furnish valuable supplementary aid to the latter during floods. At a flood control dam, the plant capability during floods normally becomes about 15 percent greater than the rated capacity, since the generators are selected to carry this amount of overload continuously, and the head on the plant becomes greater than the head at which the plant is rated as the reservoir level increases with the impounded flood water. This additional capability comes just at the time when the power capability of the plant at the navigation dam is lowered due to reduction in head by high tailwater. This coordination makes it possible generally to base the capacity value of the hydro plants of the system on the sum of the capacities of the plants under normal operating conditions.

Studies Should Cover Entire River Basin

Owing to this coordination of power plant operations, and to the fact that flood control in a river basin improves navigation by furnishing a more even river flow, it is obvious that for best results, studies must include consideration of all water uses and cover an entire river basin.

The various recent flood control and river and harbor acts contain a provision that reads as follows:

> "and provided further, that penstocks and other similar facilities adapted to possible future use in the development of hydroelectric power shall be installed in any dam authorized in this Act for construction by the War Department when approved by the Secretary of War on the recommendation of the Chief of Engineers and the Federal Power Commission."

Because of the tremendous increase in power demand during and since the war, the "future use" of power potentialities has in many cases become the immediate use. The existing area development coupled with known future demands has in several cases made it necessary to advance the schedule of multiple-purpose projects. In these cases the demand for power has been the yardstick measuring the over-all development.

The problem of allocation of costs for multiple-purpose projects is quite complicated, and has received the study of many engineers, committees, and government agencies. At least eight methods of allocation have been suggested, and no concurrence in views has been reached. It seems to the writer that there must be one fundamentally sound procedure that can be applied to all projects to give a fairly equitable distribution of costs.

Studies are yet incomplete as to the final form that one method will take but the writer believes that it will follow somewhat along the following lines:

1. Estimate the cost of a separate project for each of the water uses, and compare the annual charges for each project built for one use only with the annual benefits from that use. If each project is justifiable, find the ratio between the cost of the multiple-purpose project and the sum of the cost of the separate single-purpose projects, and allocate in this proportion.

2. When the annual benefits conferred by a water use are less than the annual charges for a project built for that use only, then the capitalized annual benefits for that use shall be substituted for the cost of the proj

CONCRETE FOR BUGGS ISLAND DAM and powerhouse substructure is poured inside sheetpile cofferdam in Roanoke River, Virginia. Initial construction of this Corps of Engineers project is estimated to cost $78,870,000. Project has primary purpose of flood control and navigation and will also provide 204,000 kw in ultimate capacity at normal operating head of 90 ft. Draft tubes are seen under construction in foreground of recent view. Initial installation is scheduled for completion in 1952.

ect, and added to the cost of those single-purpose projects which confer annual benefits greater than the annual charges. Compute a ratio between the cost of the multiple-purpose project and this sum.

The allocation to each water use can then be found by multiplying by this ratio the capitalized benefits of those uses which do not justify alternative expenditure, and by the same ratio, the cost of single-purpose projects that are justifiable.

After the cost of that part of a project chargeable to power has been determined, the annual charges for power are found by computing interest and amortization, operation and maintenance, including allowance for major replacements, and net loss of real estate taxes. To determine the economic justification of the power portion of a project, the usual method is to estimate the annual charges of equivalent dependable capacity supplied to the community by a fuel-burning plant, plus the cost of the fuel that would have been used at the steam plant in generating the kilowatt hours which the hydro plant will supply to the area in an average water year. The cooperation of the Federal Power Commission in supplying current data as to equivalent steam-power costs, as well as in forecasting the future demand for additional power in the area concerned, is extremely helpful in this part of power investigations.

Test of Economic Soundness

As has been stated, the test of economic soundness usually applied to the power phase of multiple-purpose projects studied by the Corps of Engineers is whether the capacity and the energy from a hydro development can be supplied to a power market as cheaply as the same capacity and energy can be supplied from steam plants. The Columbia River Basin, however, has potential power resources that can be developed so cheaply that many industries requiring large blocks of power find it advantageous to move to the Pacific Northwest because there power rates are considerably below those based on the cost of steam power in other parts of the country. The average discharge of the Columbia River at The Dalles, Oregon, is 194,000 cfs and the fall between the Canadian border and the Pacific Ocean is nearly 1,300 ft. With the large upstream storage reservoirs that can be built, the continuous flow can be maintained at about two-thirds the average flow. In addition, there is a tremendous amount of potential power on the tributaries—the Kootenay, Clark Fork, Clearwater, Salmon, Upper Snake and Willamette.

MC NARY COMBINED navigation and power project of Corps of Engineers on Columbia River below mouth of Snake will have total power production of 980,000 kw at normal operating head of 82 ft, at total estimated cost of $227,028,000. Columbia River basin is estimated to have 37 percent of total potential water power in United States, of which only about 13 percent is now developed. Sketch of project (top) shows general layout. Now under construction is lock and spillway end of structure (directly above) within north-shore cofferdam, which encloses 40 acres. Second construction step consists of erection of powerhouse in south-shore cofferdam, which will later be extended to junction with first section while flow of river is diverted through navigation lock.

It is estimated that 37 percent of the total potential water power in the United States lies in the Columbia Basin, of which only about 13 percent has been developed. The installed capacity, built and authorized, amounts to 5,361,000 kw; the total capacity that is expected to be installed before 1970 amounts to about 11,570,000 kw, and there remain about 10,500,000 kw that appear to be economically feasible, and about 7,000,000 kw that, in the remote future, may prove to be usable. Some of the projects, in addition to power development, are primarily useful in the improvement of navigation and for flood control, and these projects are being prosecuted by the Corps of Engineers. Those projects which primarily aid in the development of irrigation will be undertaken under the jurisdiction of the Bureau of Reclamation.

The place of hydroelectric power in the work of the Corps of Engineers is seen, therefore, to be a most important one. By sharing the cost of a project between power and other water uses, it has been economically feasible to undertake developments of great magnitude, particularly on the Columbia and Missouri Rivers—where projects that will cost $200,000,000 or more each are under way. It is probable that privately owned and operated power companies would not be in a position to undertake such large projects, and without the contribution to annual charges furnished by the sale of power, they could not be undertaken by the federal government. Federal initiative and responsibility make possible the immediate development of many of our water resources which otherwise could not be undertaken under present economic conditions.

Uplift Measurements Show Dam Designs May Be Too Conservative

HYDROELECTRIC ASPECTS of the work of the Corps of Engineers of the Army was the theme of the opening paper presented by H. G. Roby, M. ASCE, Chief of the Hydro Power Branch, Engineering Division, Civil Works, Office of the Chief of Engineers, which appears as an article

Milton G. Salzman, Chairman, Executive Committee, Power Division; Hydraulic Engineer, Ebasco Services, Inc., New York, N.Y.

elsewhere in this issue. The session was presided over by the chairman of the Power Division's Executive Committee, Milton G. Salzman, M. ASCE, Hydraulic Engineer, Ebasco Services, Inc.

Reporting on "Uplift Pressures in Concrete Dams Constructed by the Bureau of Reclamation," Kenneth B. Keener, M. ASCE, explained the significance of 22 years of measurements taken by the Bureau. His detailed report is abstracted below. Adding to the government experience was a report on "Uplift in Masonry Dams," prepared by the ASCE Subcommittee on Uplift in Masonry Dams, Power Division. The latter report was presented by Ross M. Riegel, M. ASCE, chairman of the subcommittee. Mr. Riegel is head civil engineer of the Design Department of the TVA.

Kenneth B. Keener

"In the past the maximum and most common uplift design pressure assumption used by the Bureau of Reclamation for gravity dams," Mr. Keener explained, "is that uplift pressure on the base varies uniformly from full-reservoir pressure at the upstream toe to tailwater elevation at the downstream toe, and that the pressure acts over two-thirds of the base. These assumptions were used in the design of Hoover, Mansfield, Friant, Grand Coulee, Shasta, Keswick, Kortes, and Canyon Ferry Dams."

As a check on these assumptions, the Bureau has made continuous measurements on its concrete dams for the past 22 years. Observations of uplift on a particular dam will show when additional grouting should be done or pressure-relieving drains installed to reduce pressures higher than were assumed by the designer. Such observations can be made the basis for less conservative uplift assumptions if data obtained over a long period on several dams show lower pressures than the two-thirds assumption, Mr. Keener said.

In the design of the cross sections of gravity dams, in addition to resistance to overturning, at least two safety factors are considered of especial importance, he said. The formulas, repeated here for reference, are:

$$\text{Sliding factor} = \frac{\text{Horizontal force}}{\text{Weight} - \text{Uplift}}$$

$$\text{Shear-friction factor} = \frac{(\text{Weight} - \text{Uplift}) \times \text{Coefficient of internal friction} - (\text{Horizontal area} \times \text{Unit shear resistance})}{\text{Horizontal force}}$$

"It is considered good and safe practice," Mr. Keener declared, "to keep the sliding factor well below unity and the shear-friction factor should not be less than five."

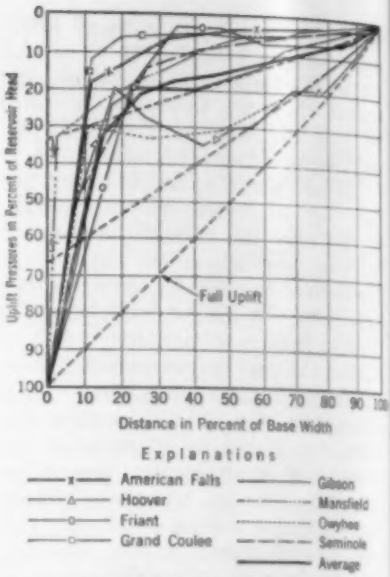


FIG. 1. MEASURED AVERAGE uplift pressures on base of several Bureau of Reclamation gravity concrete dams indicate that designers' assumptions were conservative.

After describing the installation and use of the pressure measuring devices, Mr. Keener showed detailed case histories of pressures under nine dams. (See the accompanying Fig. 1, taken from his paper.) "It is interesting to note that the measured pressures are generally less than a two-thirds uplift pressure assumption, but that, as might be expected, the higher pressures are near the upstream face of a dam," he concluded.

Bold Planning Required to Solve Washington's Traffic Problems

NOT UNTIL a new policy with respect to federal employment centers is established will Washington's traffic problem be solved, stated Harland Bartholomew, M. ASCE, city planning consultant from St. Louis, Mo., and the first of four speakers in a symposium presented at the City Planning Division session at the Washington, D.C., Fall Meeting. The symposium title was, "Comprehensive Plan for the National Capital," and Mr. Bartholomew's subject was "The Plan Contrasted with Other City Plans."

Other speakers in the symposium were John Nolen, Jr., Assoc. M. ASCE, Director of Planning, National Capital Park and Planning Commission, who covered the "Principal Features of the Plan"; F. W. Tuemmler, Assoc. M. ASCE, Director of Planning, Maryland National Capital Park and Planning Commission, speaking on "Techniques in Guiding Suburban Planning"; and William H. Cary, Jr., Director, Bureau of Public Health Engineering, Health Department, District of Columbia, Washington, D.C., whose paper dealt with "Determining Conditions in Redevelopment Areas."

The session was presided over by John M. Picton, M. ASCE, a member of the City Planning Division's Executive Committee, and Chief Planning Engineer, City Plan Commission of Kansas City, Mo.

The opening paper, "The New Towns Program in Britain," was pre-

pared by T. C. Coote, Senior Planning Officer, British Ministry of Town and Country Planning. In the absence of Mr. Coote, the paper was read by Jacob L. Crane, M. ASCE, Consulting Engineer and Assistant to the Administrator, Housing and Home Finance Agency, Washington, D.C.

"Urban Expansions—Problems and Opportunities in American Metropolitan Areas," were enumerated in a paper by C. McKim Norton, Executive Vice-President, The Regional Plan Association, New York, N.Y. Mr. Norton's presentation was discussed by Tracy Augur, Urban Planning Officer, General Services Administration, Washington, D.C., and by T. T. McCrosky, M. ASCE, Partner, McHugh & McCorsky, Community and Regional Development Consultants, New York, N.Y.

Papers received at ASCE Headquarters prior to the Fall Meeting are reviewed below.

Harland Bartholomew

Washington's traffic problem will not be solved until a new policy is established and enforced with respect to federal employment centers, Mr. Bartholomew declared. The present centralization is not merely impractical from the standpoint of traffic congestion but is also unfortunate from the viewpoint of general planning and well-being of the city.

Speaking of the L'Enfant plan, the speaker declared that the magnificent conception of L'Enfant is unsurpassed in city planning annals. Much of the beauty we admire today is due to this early plan, although too much cannot be said in commendation of the many persons in public office as well as in private life who have worked painstakingly for the continuous improvement of the city.

However, the speaker averred, it is not to be expected that L'Enfant could have anticipated many of the difficulties faced by American cities today. The enormous growth of Washington and the corresponding traffic load imposed upon the street system have emphasized the significance of the location of employment centers in planning. Few modern cities, he said, have effectively controlled the location of such centers by planning, and hence it is not surprising to find that Washington, despite its generous provision of streets, experiences acute traffic congestion.

John M. Picton, Member, Executive Committee, City Planning Division; Chief Planning Engineer, City Plan Commission, Kansas City, Mo.

This congestion and confusion, Mr. Bartholomew maintained, is not chargeable to deficiencies in the L'Enfant Plan, but to subsequent lack of bold planning in the arrangement of the business district and of a more firm and intelligent policy in the location of federal employment centers.

Fortunately, asserted the speaker, the type of planning needed to solve Washington's problems will not require the expenditure of large sums of money, but rather of time and effort in establishing new policies, especially with respect to the location and distribution of the employment centers previously referred to, and securing the necessary cooperation of all concerned to assure adherence to the policy and program agreed upon.

T. C. Coote

Speaking of the New Towns Program, Mr. Coote outlined its development from the birth of the program up to the present time. The paper included a listing of the many towns built, under construction, and being planned. The purpose of the program is to build new communities on new sites and rebuild communities on old sites. The program has added materially to the well-being of the people in the industrial areas of Great Britain.

F. W. Tuemmler

The future needs of an expanding community must be anticipated, Mr. Tuemmler said. The problems grow increasingly complex if the needed rights-of-way have not previously been provided. It has been found that a well-developed legislative program can greatly expedite the procuring of these rights-of-way and facilitate the expansion plans.

Washington, D. C., Needs Additional Airport Facilities

THE DISTRICT of Columbia needs a supplementary airport now, Phillips Moore, Director, Office of Airports, Civil Aeronautics Administration, Washington, D.C., stated before the Air Transport Division in a paper of particular interest for Washingtonians. This need, the speaker said, is common to many metropolitan areas.

This session of the Air Transport Division, held in connection with the Washington, D.C., Fall Meeting, was presided over by Everett C. Crites, M. ASCE, Chairman of the Division's Committee on Airport Standards, and Chief of the Project Review Division, Civil Aeronautics Administration.

Economic studies being conducted by the CAA to determine a community's need for airport facilities were described in a second paper presented at this session, by A. D'Arcy Harvey, Chief, Research and Analysis Division, CAA. A third paper, by Paul A. Smith, M. ASCE, Rear Admiral, U.S. Coast and Geodetic Survey, and representative on the International Civil Aviation Organization Council, told of the many activities of the ICAO and of its objective to standardize international aeronautical activity for the general safety of all member nations.

Phillips Moore

As a result of the rapid growth of aviation, stated Mr. Moore in his paper, there is no single airport in any major metropolitan area which, considered adequate only a decade ago and constantly expanded and improved during the subsequent years, is capable of meeting the aeronautical requirements of the present day, to say nothing of those which will exist in the future.

As compared to 1948, the speaker pointed out, the number of plane passengers in the United States will increase 70 percent by 1955, it is estimated, air cargo will increase sixfold, and the number of civil air-

craft will jump from 1948's ninety thousand to an estimated four hundred thousand in 1955.

Referring specifically to Washington, D.C., the speaker declared that this city needs a supplementary airport for air passenger service now, a conclusion, which has been reached only after exhaustive study and investigation of all pertinent factors.

He then analyzed the air cargo transport facilities of Washington, D.C., which he said were inadequate but could be handled if another passenger airport were available. Facilities for resident and non-resident private flying also do not fill present needs. The speaker then referred to the results of a recent study which indicate that a total of 17 additional strategically located small airports will be required for Washington, D.C., and the surrounding area within the next ten years.

An opportunity to use the two military airfields in the city for commercial or private flying is quite unlikely to materialize, Mr. Moore said.

Paul A. Smith

Speaking on the general theme of the opportunities of the civil engineer in international civil aviation, Mr. Smith stated in his paper that such opportunities are many and varied and include, as in the United States, all the fields of design, construction and maintenance.

He then referred to the International Civil Aviation Organization's activities in adopting international standards and recommended practices (known as annexes to the Convention). These annexes will go to make up the international code of engineering and operational specifications so essential to safe, regular and economical air transport.

The convention is empowered to recommend improvements to mem-

Everett C. Crites, Chairman, Committee on Airport Standards, Air Transport Division; Chief, Project Review Division, Civil Aeronautics Administration, Washington, D.C.

ber states whose aircraft facilities are inadequate or unsafe, the speaker stated. In the event that a member state is not able financially to carry out the recommendation, the Council may provide a portion or all of the costs and may even establish a staff and operate the required facilities if the state so requests.

Such activity as that in which the ICAO engages serves to spur international aviation to greater expansion, and opportunities for engineers in this realm multiply accordingly.

A. D'Arcy Harvey

For three years the CAA Office of Airports has been engaged in a research program to develop ways and means by which a community's need for airports could be ascertained and measured. A substantial part of this program has been completed, Mr. Harvey said, and the results have been made known to the public in a series of booklets.

Because of the complexity of the program the speaker did not attempt to go into detail, but limited his discussion to the economic basis for determining a community's aeronautical need for terminal airports to serve commercial aviation. Mr. Harvey outlined the subject under the following topics.

1. Population of communities
2. Economic character of communities
3. Measurements and forecasts of air transportation
   - (*a*) Airline passengers
   - (*b*) Air mail
   - (*c*) Air cargo
4. Conversion of air traffic forecasts into runway requirements
5. Conversion of air traffic forecasts into terminal area requirements

The importance of economics in airport planning as done by the CAA was stressed by Mr. Harvey. The effort is a continuing one, he said, and future activities in the field should produce a rich harvest.

Productive Fields for Research in Sanitary Engineering Outlined

"SANITARY ENGINEERING, like other fields of scientific endeavor, has depended on research to stimulate its progress from crude beginnings to its present advanced state as an applied science," Prof. Rolf Eliassen declared in his paper presented at the session of the Sanitary Engineering Division at the Society's Fall Meeting in Washington, D.C. Professor Eliassen is head of the Department of Sanitary Engineering at the Massachusetts Institute of Technology. His paper is abstracted below.

"Since 1941 the Interstate Commission on the Potomac River Basin has been struggling to obtain a uniform control of river pollution," Harold A. Kemp, M. ASCE, Director of Sanitary Engineering, District of Columbia, told members of the Sanitary Engineering Division at the same session. "The Potomac

Alfred H. Wieters, Secretary, Executive Committee, Sanitary Engineering Division; Water Pollution Control Division, U.S. Public Health Service, Washington, D.C.

River has an ability to absorb and purify wastes greater than most streams in the United States," he said, but presently constructed sewage treatment plants fall short of holding pollution load down to a safe figure. An article based on Mr. Kemp's paper is anticipated for the December issue.

This session of the Sanitary Engineering Division was presided over by Alfred H. Wieters, M. ASCE, secretary of the Division's Executive Committee, with the Water Pollution Control Division, U. S. Public Health Service, Washington, D. C. Besides those mentioned, two papers were presented: "Hygiene of Housing," by M. Allen Pond, Assistant Chief Engineer, U.S. Public Health Service; and "Aspects of Sanitary Engineering in

(*Continued on page 90*)

Engineers' Notebook

Approximate Influence Lines Aid in Design of Continuous Beams

A. A. BRIELMAIER, M. ASCE
Professor of Civil Engineering, Washington University, St. Louis, Mo.

APPROXIMATE influence lines, if they can be quickly obtained, are of great assistance in the preliminary design of continuous beams, particularly for continuous girder or stringer bridges. A method is here presented which permits the ready determination of such influence lines for a series of equal or unequal spans. The analytical work involved is limited to the solution of the continuous beam for each span in turn uniformly loaded.

Any function of the load, beam section and span can be described by means of influence lines. The influence line is a curve drawn for the entire length of the beam, the ordinate to which, at any point, is the value of the function when a unit load is placed at that point. The area under the curve in any one span represents the value of the function when that span is uniformly loaded with a unit load.

The functions which are usually of interest in preliminary design are the moments, shears and reactions. By means of the Mueller-Breslau principle (see Cross and Morgan, *Continuous Frames of Reinforced Concrete*), the shapes of the influence lines for these functions can be sketched. Before these lines can be of specific benefit however, the values of the areas under the line within each span length and of the ordinates at critical points must be known. The example illustrated in Fig. 1 shows how the areas can be determined accurately and also how the ordinates can be determined accurately for midspan and approximately for other points.

Example to Illustrate Method

A beam of constant section, continuous over three spans of 40, 60, and 50 ft, respectively, is shown in Fig. 1 (*a*). Span AB is loaded uniformly with 1 kip per ft, and the fixed-end moments at A and B are computed. The final moments at all supports are then determined by moment distribution or by some other method. These fixed-end and final moments are tabulated in Table I. The table also contains the moments for spans BC and CD, each in turn loaded uniformly. Moments with a negative sign indicate tension in the top of the beam.

The final moments at the supports, for a load of 1 kip at the center of span AB, can be obtained from the results for AB uniformly loaded, since the final moments will be in the same ratio as the fixed-end moments. When span AB is uniformly loaded, the fixed-end moments at A and B are 0 and -200 ft-kips, respectively, and the corresponding final moments are 0 and -88 ft-kips. When the same span has a unit load at midspan, the fixed-end moments are 0 and -7.5 ft-kips. Then the final moments are (7.5/200) 0 ft-kips and (7.5/200) (-88 ft-kips), resulting in 0 at A and -3.3 ft-kips at B. The fixed-end and final moments for each span in turn loaded at the center, are listed in Table I.

The moment curves for the three cases of uniform loading are drawn in Fig. 1 (*b*). The numerical values for the moments at supports and at midspans are the values of the areas in the loaded span, under the influence lines for these moments. For example, the influence line for the moment at support B will have an area of -88 ft^2 in span AB, of -210 ft^2 in span BC, and of $+46$ ft^2 in span CD. The moment curves for the cases of midspan loading are shown in Fig. 1 (*c*).

The numerical values are ordinates on the influence lines for moments. For example, the influence line for the moment at midspan of AB will have an ordinate at that point of $+8.4$ ft, and the influence line for the moment at support B will have an ordinate of -3.3 ft at midspan of AB. However, the ordinates at midspan obtained for influence lines for midspan moments are of more importance than the ordinates at midspan obtained for support moments.

Two typical influence lines for moment are shown in Fig. 1 (*d*) and (*e*), that for the midspan moment in AB and for the moment at support B. The areas under these lines in each span and the ordinates at midspans have already been discussed. Where the influence line is an unbroken curve over an entire span, with ordinates always of the same sign, an approximate value for the maximum ordinate can be simply obtained by considering the curve to be parabolic. Then the maximum ordinate is $1^1/_2$ times the average ordinate. In span BC of Fig. 1 (*d*) the area is -105 ft^2 and the average ordinate is then -1.75 ft. The approximate value for the maximum ordinate is -2.6 ft. In constructing the influence line, this maximum ordinate locates a line drawn parallel to the base line, to which the curve will be tangent. The influence line of known shape is then drawn in smoothly by means of a French curve.

Influence Lines for Shears and Reactions

The preceding paragraphs have considered only influence lines for critical moments. In similar manner, the lines for shears and reactions can be obtained. However, before constructing these lines, it would be advisable to sketch the free-body diagrams, showing loads and reactions for each span and for each of the three cases of uniform loading. The shears and reactions from these diagrams would then be the areas under the influence lines.

The example given is a three-span continuous beam of constant section. In the final design, the beam would probably not be of constant section and a re-analysis would be required. The results of this re-analysis often agree very closely with those based on the assumption

TABLE I. MOMENTS AT SUPPORTS FOR ONE SPAN LOADED

Loaded Span	Moments*	M_{BA}*	M_{BC}*	M_{CB}*	M_{CD}*
Load of 1 kip per ft on one span					
AB	Fixed-end	−200 ft-kips	0	0	0
	Final	−88	−88	+24	+24
BC	Fixed-end	0	−300	−300	0
	Final	−210	−210	−191	+191
CD	Fixed-end	0	0	0	−313
	Final	+46	+46	−155	−155
Load of 1 kip at center of one span					
AB	Fixed-end	−7.50	0	0	0
	Final	−3.3	−3.3	+0.9	+0.9
BC	Fixed-end	0	−7.50	−7.50	0
	Final	−5.3	−5.3	−4.8	−4.8
CD	Fixed-end	0	0	0	−9.3
	Final	+1.4	+1.4	−4.6	−4.6

* M_{BA} = moment at B in span AB; M_{BC} = moment at B in span BC; etc.

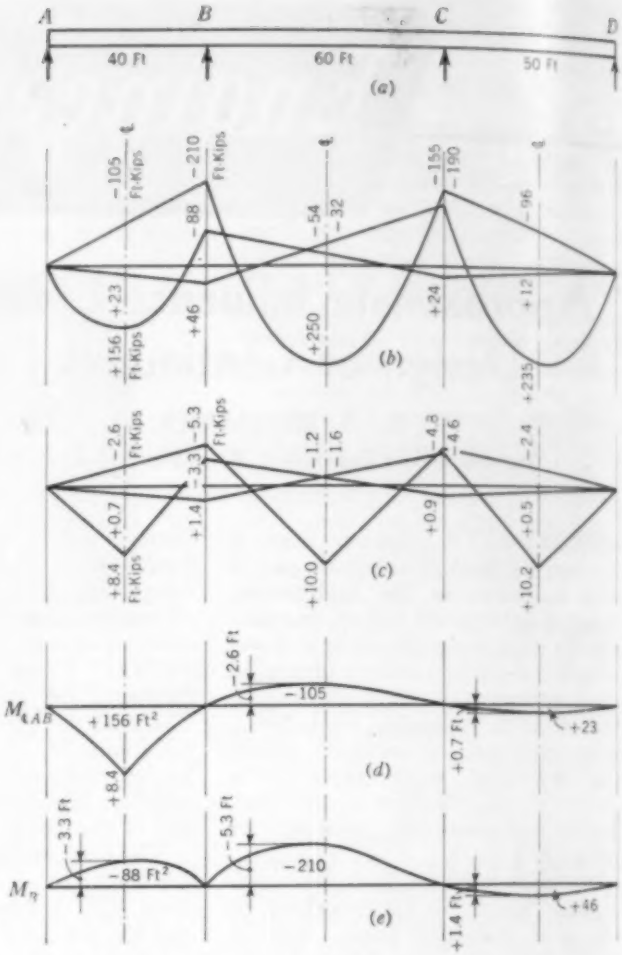


FIG. 1. (At right) Use of approximate influence lines simplifies preliminary design of continuous beam. Beam of constant section, continuous over three spans of 40, 60 and 50 ft, respectively, serves as example of method, (*a*). Moment curves are drawn for three cases of uniform loading, (*b*), and for cases of midspan loading, (*c*). Typical influence line for midspan moment in *AB* is shown in (*d*), and typical influence line for moment at support *B* in (*e*).

of constant section. The method here outlined is not limited to beams of constant section but can be applied also to beams or frames of constant or varying section, with or without sidesway. In these more complex cases, however, it may be desirable to construct more accurate influence lines, even for preliminary design.

Curves Solve Reservoir Flood Routing Equations

KENNETH E. SORENSEN, Jun. ASCE

Harza Engineering Co., Chicago, Ill.

CALCULATION of reservoir elevation and spillway discharge for conditions of variable inflow, assuming a level pool surface, involves solution of the differential equation,

$$dV = (I - S)dT \quad . \quad . \quad . \quad (1)$$

in which

V = reservoir volume
I = rate of inflow
S = spillway discharge (outflow)
T = time

This equation is not amenable to a mathematical solution as I is a function of T, and S is a function of V.

Equation 1 can be approximated as

$$\Delta V = V_f - V_i = \left(\bar{I} - \frac{S_i + S_f}{2}\right)\Delta T \quad . \quad . \quad . \quad (2)$$

in which $\bar{I}$ is the average inflow for the period ΔT and the subscripts i and f refer to the initial and final conditions of the period ΔT. Equation 2 in the transposed form,

$$V_f + \frac{S_f \Delta T}{2} = V_i - \frac{S_i \Delta T}{2} + \bar{I}\Delta T \quad (3)$$

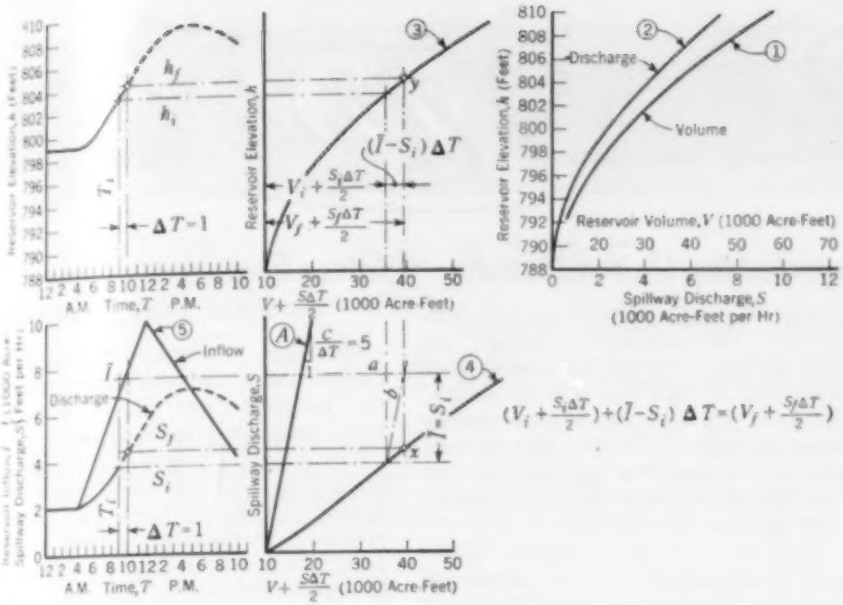
can be solved for V_f by arithmetic methods or by use of special slide rule (described in *Hydraulics of Steady Flow in Open Channels*, by S. M. Woodward and C. J. Posey, John Wiley and Sons, 1941, p. 133).

A graphical solution is possible by transposing Eq. 2 to read

$$\left(V_i + \frac{S_i \Delta T}{2}\right) + (\bar{I} - S_i)\Delta T = V_f + \frac{S_f \Delta T}{2} \quad . \quad . \quad . \quad . \quad (4)$$

For any particular reservoir the curves of Fig. 1 can be plotted. Curves 1 and 2 are the reservoir volume and spillway discharge curves plotted as functions of reservoir elevation. By selection of some constant value for ΔT (i.e., one hour, six hours, one day, etc.) values of $V + (S\Delta T)/2$ can be plotted as a function of reservoir elevation as shown by Curve 3, and as a function of spillway discharge as shown by Curve 4. Curve 5 is the inflow hydrograph plotted to the same scale as spillway discharge. Line A has a slope equal to $c/(\Delta T)$ wherein c is the ratio of the $V + (S\Delta T)/2$ scale to the S scale.

The example shown in Fig. 1 will serve to illustrate the graphical solu-



$$(V_i + \frac{S_i \Delta T}{2}) + (\bar{I} - S_i)\,\Delta T = (V_f + \frac{S_f \Delta T}{2})$$

FIG. 1. Curves solve for reservoir elevation and spillway discharge when average inflow for given time increment is known. Level pool is assumed.

tion of Eq. 4. Curves 1, 2, 3 and 4 have been drawn for a specific reservoir with ΔT taken as one hour. The scale ratio c is 5.0 and determines the slope of line A. Curve 5 is the inflow hydrograph for which routing is desired. At 9:00 a.m. the reservoir elevation, h_i, is known to be 803, for which the spillway discharge, S_i, is 3,750 acre-ft per hour. To determine the reservoir elevation one hour later (10:00 a.m.) the following steps are taken:

1. Horizontal line a is drawn through the average inflow, $\bar{I}$, for the period 9:00 a.m. to 10:00 a.m.
2. Line b is drawn parallel to line A from the intersection of spillway discharge, S_i, of 3,750 and Curve 4.
3. The intersection point of lines a and b is projected vertically to points x and y of Curves 4 and 3.
4. Point y is projected horizontally to give the reservoir elevation h_f, at 10:00 a.m.
5. Point x is projected horizontally to give the spillway discharge, S_f, at 10:00 a.m.
6. With the new reservoir elevation and spillway discharge values as initial conditions, the foregoing Steps 1 through 5 are repeated for the next hourly increment.

The final results obtained are the reservoir inflow and outflow hydrographs superimposed and the reservoir stage hydrograph. If the latter is not desired, the upper half of Fig. 1 and use of Curve 3 can be omitted. Curves 1 and 2 are not directly involved in the graphical solution but are source data for the plotting of Curves 3 and 4, and if available elsewhere, need not be redrawn for this solution.

Graphical and Nomographic Solution Combined

A combination graphical and nomographic solution of Eq. 3 is possible. Letting

$$y = V_f + \Delta T \frac{S_f}{2} \quad . \quad . \quad . \quad . (5a)$$

and

$$y' = V_i - \Delta T \frac{S_i}{2} \quad . \quad . \quad . \quad . (5b)$$

equations are obtained of the form,

$$y = \phi_1(h) \pm \Delta T \phi_2(h) \quad . \quad . \quad . (6)$$

which fit a basic nomographic type. (See *Nomography* by A. S. Levens, John Wiley, 1948, page 121.)

Figure 2 shows the nomographic solution of Eqs. 5(*a*) and (*b*), ΔT being measured downward for (*a*) and upward for (*b*). Equation 3 becomes

$$y = y' + \bar{I}\Delta T \quad . \quad . \quad . \quad . (7)$$

and solution of the flood routing problem is as follows:

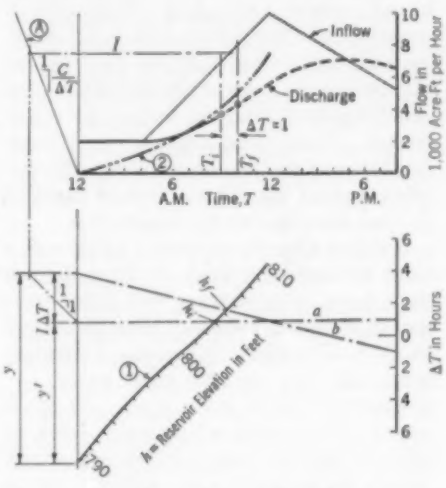
1. Draw line a through h_i and the upper value of ΔT, thus solving for y'.
2. Add $\bar{I}\Delta T$ to y', giving y.
3. Draw line b through y and the lower value of ΔT. The intersection with the h curve gives the value of h_f.

Figure 2 shows this method applied to the same reservoir and flood as in Fig. 1. In the upper portion of Fig. 2 is shown a means of graphically adding $\bar{I}\Delta T$ to y' by projection through line A. The slope of line A is $c/\Delta T$ in which c is the ratio of the I scale to the y scale. Curve 2 is the spillway discharge rating curve plotted with discharges as ordinates against the reservoir elevations of Curve 1 below. Thus by projecting upward from h_f of Curve 1 to Curve 2, and then horizontally to T_f, a graphical plot of the spillway discharge hydrograph is obtained. The reservoir stage hydrograph, if desired, can be obtained similarly. The plotting of Curve 1 of Fig. 2 is relatively simple using the short-cut methods given on page 124 of the above mentioned text on nomography.

Advantage of Nomographic Method

The nomographic method has an advantage over the graphical method in that the curves plotted are independent of ΔT. Thus Curve 1 of Fig. 2 need be plotted only once for a given reservoir, and floods can be routed using any convenient value for ΔT, and in fact ΔT may be changed at will during the routing if elevation changes become too large or too small.

It is believed that both solutions have certain advantages over other methods in the form of presentation of final results and in reduction of potential errors in interpolation inherent in methods requiring the reading of values from graphic scales.



$$\left(V_f + \frac{S_f}{2}\Delta T\right) = \left(V_i - \frac{S_i}{2}\Delta T\right) + \bar{I}\Delta T$$

$$y = V_f + \frac{S_f}{2}\Delta T = \phi_1(h_f) + \Delta T \phi_2(h_f)$$

$$y' = V_i - \frac{S_i}{2}\Delta T = \phi_1(h_i) - \Delta T \phi_2(h_i)$$

$$y = y' + \bar{I}\Delta T$$

FIG. 2. NOMOGRAPH solves for reservoir flood routing at level pool for same reservoir and same flood as in Fig. 1.

...THE READERS Write

Conservation Conference Sponsored by United Nations

DEAR SIR: There is a misstatement on page 59 of the September issue of CIVIL ENGINEERING, regarding the recent United Nations Scientific Conference on the Conservation and Utilization of Resources (UNSCCUR).

The item bears the title "UNESCO Mobilizes World's Conservation Experts," and in the first paragraph the gathering is referred to as "a UNESCO-guided Scientific Conference on the Conservation and Utilization of Resources." The fact is that UNESCO had nothing whatsoever to do with the Conference, which was called by the Secretary-General of the United Nations under a resolution of the Economic and Social Council.

The confusion was probably caused by the fact that a joint conference called by the International Union for the Protection of Nature and UNESCO, and dealing with the protection of nature, was held at Lake Success for several days while the UNSCCUR was in session. However, the Conferences were entirely separate, and UNESCO was not in any way concerned in the larger gathering, though several of the other specialized agencies did participate in it.

The *Handbook of the United Nations and the Specialized Agencies*, obtainable from the Columbia University Press at $1 a copy, may help to clear up some of the misinformation that still exists regarding the United Nations and its various organs and agencies.

EDMUND A. PRATT, M. ASCE
(EJC Representative at UNSCCUR)

New York, N.Y.

Effects of Aquatic Life on River Hydraulics Described

TO THE EDITOR: The article by E. W. Lane, in the September issue, on temperature increases as reducing sediment transportation in rivers, opens up a much neglected phase of river hydraulics—namely, the effects of insolation and of the various forms of aquatic life and vegetation on the top layer of the bed and underwater banks of streams during the warm season. These cause a slippery gelatinous condition of the top layer, which effectually prevents the entrainment of much of its finer constituents by stream flow.

Outdoor laboratory models fashioned in sand are similarly affected when not in use. Even in the short period of two summer days over a weekend, river models at the U.S. Waterways Experiment Station, lying idle but covered with water, became coated with green algae and often were found teeming with minute forms of life. In the Mississippi River, the writer found these conditions existing to a marked degree. Samples of bed-surface material collected in buckets, kept covered with river water, and transferred to empty gold fish bowls, after a few days proved to be inhabited by a variety of minute organisms and, in time, produced an underwater flora quite as remarkable. A slimy layer formed on the glass walls and evidently coated the surfaces of the soil and of plant life also.

The inhibiting influence of these conditions on sediment transportation in streams, especially in its effect on the smaller grain sizes, during the summer months seems obvious. Mr. Lane emphasizes the fact that in the Colorado River increased temperatures affected particularly the sediment sizes smaller than 0.3 mm, resulting in an appreciable reduction in sediment transported. The very opposite condition, however, obtains in indoor laboratory flumes not exposed to sunlight. Experiments made by Pang-Yung Ho in Berlin in 1939 showed that the movement of sediment in such a flume, in which no organisms were permitted to propagate, was greatest at the higher temperatures and least during low temperatures. Other experimenters working indoors confirm this, the inference being that the decrease in the viscosity of water with increasing temperature, promotes entrainment of sand grains. In the case of natural streams, sunlight and increasing temperatures also serve to decrease viscosity, but this is entirely offset by the decreased erodibility of the bed and banks caused by organic agencies.

GERARD H. MATTHES, Hon. M. ASCE

New York, N.Y.

Gives Engineering Firms on New Jersey Turnpike

DEAR SIR: I wish to call attention to an omission in the news item relative to the proposed New Jersey Turnpike, which appeared in the August issue.

The following consulting engineering firms have been employed by the New Jersey Turnpike Authority and they are proceeding with studies leading to a report, which will be utilized in financing by revenue bonds.

1. The firms of Ammann & Whitney, Edwards & Kelcey, Frederic R. Harris, Inc., O. J. Porter & Co., Newark, are acting as a single associated organization and are to make an engineering report for the northerly portion of the turnpike, extending from Bonhamtown, N J., at the Raritan River north to the vicinity of the George Washington Bridge.
2. De Leuw, Cather & Co., Chicago, Ill., are making an engineering study and report for the southern portion of the turnpike, from Bonhamtown, south to a connection with the new Delaware Memorial Bridge, now under construction by the Delaware State Highway Department at Deepwater, N.J.
3. Coverdale & Colpitts, New York, N.Y., are making a traffic and revenue study for the entire turnpike from Deepwater to the George Washington Bridge.
4. The firm of Howard, Needles, Tammen & Bergendoff, New York, N.Y., are serving as general consultants to the Authority.

CHARLES M. NOBLE, M. ASCE
Chief Engineer, New Jersey Turnpike Authority

Trenton, N.J.

Procedure for Handling Log Logs Clarified

DEAR SIR: There is a printer's error in my communication entitled "Standard Procedure for Log Logs Recommended," published on page 45 of the August issue.

In the tabular example, the first item ($x = -0.25$) should be opposite the *T* and not the *N* form of the log.

F. T. LLEWELLYN, M. ASCE
Baton Rouge, La.

SOCIETY NEWS

Revision of ASCE Constitution Proposed

Arthur W. Harrington, M. ASCE
Former ASCE Vice-President, Chairman of the Special Committee on Constitution and By-Laws

QUESTIONS HAVE BEEN ASKED by members and by Local Sections about parts of the currently proposed revision of the Society's constitution. Similar questions may be in the minds of others. The following comments by the chairman of the Special Committee on Constitution and By-Laws may clear up these and other questions relating to this important proposed action by the Society.

It should be borne in mind that the signing of a petition to the Board of Direction to bring any ASCE constitutional amendment before the membership for ballot does not constitute a vote on the amendment. Signers of petitions are not committed to the exact language of any amendment so proposed nor are they committed as to their eventual vote on it. A sufficient number of petitions having been received, a constitutional amendment is in order for discussion at an official business meeting of the Society. Changes in the proposal may be made at that time, in any manner pertinent to the original amendment. The exact wording of the amendment, which then goes to the membership for letter ballot, is decided upon at the business meeting.

In the past it has been a comparatively easy matter from time to time to effect the adoption of amendments proposed for sections of our constitution, except for those sections covering membership grades or dues. For nearly a century, our constitution has been amended and amended by sections. So far as the record shows, it never has been studied and rewritten with a view to amendment as a whole. Our present constitution, patched and repatched, is a very confusing document. It contains many ambiguities, some downright conflicts, and much material which properly belongs in by-laws. Over two years ago the Board organized a committee of qualified members and assigned to it the task of preparing a draft of a constitution, new throughout.

The Board directed the Special Committee to follow closely the intent of the present constitution. There was to be included in the new draft only those items essential to delineate the form of the organization, its general objectives, and its powers. In accordance with these instructions, the Special Committee attempted to achieve a more coherent arrangement of the fundamental laws under which our Society is governed and to eliminate from its draft of the new document all phraseology not absolutely

Arthur W. Harrington

essential to record the basic law of the Society. All secondary items required to fill in detail and all items subject to probable frequent change were relegated to the by-laws.

Board Approves Draft

After extensive work by the Committee, and referral of several tentative drafts to the Board, a final draft was approved by the Board at the July 1949 meeting. The approved draft was circulated to the Local Sections on August 19. The requisite member signatures, and more, were received at headquarters before the "first Wednesday in November" petitioning the Society to consider the proposed new constitution as an amendment to the present document. The proposal, therefore, must be placed before the January 1950 business meeting of the Society. This business meeting has authority to send the proposal, as received or as amended, to all the members for letter ballot. A two-thirds affirmative vote of all votes cast is necessary for final approval.

Adoption of this revised, brief and clear constitution, as proposed, will give the Society a clean, understandable starting point for future changes found desirable. The constitution of our Society never has been sacrosanct. It has been changed so often that there is no record of the number of changes made during the near century of its existence. The new constitution, if adopted, also will be changed from time to time although making it brief and clear at the outset should minimize future constitutional changes.

Rewriting By-Laws Will Follow

As stated, some of the provisions of the present constitution are to be covered in new by-laws which will fill in all necessary details of Society administration authorized in the constitution. As by-laws are of such importance, some members have indicated that they would like to be furnished a copy of the proposed by-laws before they vote on the proposed constitution. The Special Committee appreciates this feeling but finds it impracticable of fulfillment. Compilation of the by-laws which will be required is a long and arduous task. New by-laws must be based on the new constitution. In many places, specific reference to specific sections of the constitution are required. It is essential that a constitution be decided upon before by-laws are compiled, if wastage of time and effort is to be avoided.

The Special Committee has proposed, with Board approval, to produce new by-laws as soon as practicable after a new constitution is adopted. When the Board approves new by-laws, they will be printed and circulated to all members. In the interval between old and new by-laws, the present by-laws would govern, except for a few minor details where they are in conflict with the constitution. Amendments to by-laws are made by the Board under provision of Section 6, Article X of the present constitution, as well as in the new document. By-laws are not referred to the entire membership for approval by ballot.

It appears reasonable for the members to leave the multiplicity of by-law de-

tails to the good faith of the Board—at least until a first set of new by-laws has been published. If members or Local Sections then have any criticism of them, it will be a simple matter to bring suggestions for betterment to the Directors from their respective Districts so that any changes proposed can be brought promptly to the Board.

Membership Grades Remain for Later Decision

It has been suggested that adoption of the proposed new constitution should be voted upon section by section. The idea advanced is that by such a method each member could approve those parts of the document he thought good and reject others. Such action is not practicable in this situation, as all the articles and sections of the new constitution were not and could not be matched up with corresponding provisions of the old constitution. Both the Special Committee and the Board believe that the most practical method now is to vote on the new document as a whole, which, of course, always will be subject to amendment.

Inquiry has been made as to why existing membership grades are retained when it is contemplated that new grades may be established on the basis of recommendations expected shortly from ECPD. A new constitution and the adoption of new membership grade classifications are properly separate questions. The Board has not thought it appropriate to anticipate some final decision on membership grades by ECPD. The injection of this important question or others into the simple proposal to put our present constitution into proper and understandable language, without change in spirit or intent, would serve to complicate the proposal unduly.

The matter of membership grade changes can be carefully considered after ECPD makes its report and after the proposed new constitution is on the record—if approved. The subject of grades is important by itself and should stand or fall on its own merits. Opportunity for full consideration of this matter by all our Local Sections appears most desirable. There seems little point in postponing the cleaning up of our present constitution pending a future decision on the subject of membership grades.

Board May Allocate Funds to Sections

Some Local Sections have inquired about Local Section allotments under the proposed constitution. Our present constitution states in Article IX that "the Board of Direction may annually assign . . . . funds to each Local Section." The word "may" in this clause should be noted. The allotment formula is set up in the present by-laws, Article VII, Section 5. This by-law is subject to change in the same manner as any other by-law. It is reviewed annually by the Board in connection with its consideration of the annual budget.

There is no real change on the subject of Local Section allotments as between the present constitution and that proposed. Under the present constitution, the Board may or may not allocate funds to Local Sections. The same situation prevails under the proposed new constitution. The new constitution carries full authority for the Board to allocate Society funds for Local Sections or for any other purpose falling within the general powers of the Board as provided in the constitution.

Annual Meeting in October

The proposed change in the date of the Annual Meeting in New York from mid-January to October, also has raised a question. This proposed change results from complaints by many members annually relating to the January schedule. January in New York frequently furnishes the worst weather of the year. October generally is one of its most pleasant months. Hotel accommodations in New York in October are easier to obtain than in January, which is one of the peak convention months. Successive Boards of Direction have voiced the opinion that an October date for our annual meeting would increase meeting attendance and be otherwise desirable in many ways.

The writing of a sound constitution and by-laws for a Society such as ours is not a simple matter. The Special Committee, frequently advised by the Board, has produced a workable draft of a new constitution which does not depart in any essential from the sense of the old constitution. The new draft has been approved by the Society's attorneys. Two years' time and no little effort went into the drafting. If there are errors of omission in the draft they can be corrected at the business meeting next January, provided that the changes proposed are pertinent to the document under petition. Necessary changes in the new constitution, when adopted by ballot, can be made in the future as they have been made in the past. Adoption of a new, concise and clear constitution, after about a hundred years of amendments to the old one, will give the Society a fresh starting point which, the Special Committee hopes, will serve as a constitutional base for another century of ASCE progress.

W. J. E. Binnie, Honorary Member of Society, Dies

FROM ENGLAND COMES word of the death of William James Eames Binnie, Hon. M. ASCE, at Tilehurst, Berkshire, on October 4. Mr. Binnie, who lacked a few days of being 82, retired last year from active practice as a long-time member of the London consulting firm of Binnie, Deacon & Gourley.

Educated at Rugby and Cambridge, where he graduated with honors in natural science in 1888, Mr. Binnie had early engineering experience on the construction of a water supply system for Birmingham, the Central London Tube Railway, and the Khedival Graving Dock at Alexandria, Egypt. From 1902 on he was connected with his father's firm, which carried

W. J. E. Binnie, 1867–1949

out many important water-supply projects both at home and abroad. Mr. Binnie was also engaged in hydroelectric work, and was active in promoting legislation leading to the current hydroelectric development of the Scottish Highlands.

Mr. Binnie had served as president of the British Institution of Sanitary Engineers, the Institution of Water Engineers, and the Institution of Civil Engineers. He was also a past-president of the British Section of the Société des Ingenieurs Civils de France, and was recently awarded the Legion of Honor for his services to the two countries. He had also been a member of the British Committee of the International Commission on Large Dams of the World Power Conference, and was its chairman from 1933 to 1946. A member of ASCE since 1929, Mr. Binnie was elected Honorary Member in 1939.

New York Members Plan Diverse 1950 Annual Meeting Program

Dates Are Set for January 18–20

AN EXTENSIVE TECHNICAL program, attendance at a meeting of the United Nations Assembly, inspection of the permanent U.N. Headquarters under construction, numerous social events, and a post-convention trip to Bermuda are some of the highlights of the program for the 1950 Annual Meeting of the ASCE. The Commodore Hotel in New York has been selected again as the meeting headquarters, and the dates will be January 18–20.

18 Technical Sessions Scheduled

Ten Technical Divisions have planned 18 sessions, with programs of interest to civil engineers in every field. Divisions participating will be the City Planning, Construction, Highways, Hydraulics, Power, Sanitary Engineering, Structural, Soil Mechanics and Foundations, Surveying and Mapping, and Waterways. Of special interest will be a symposium on construction of the permanent U.N. Headquarters in New York. This session will be supplemented with a specially conducted tour of the project, which is located only a few blocks from the headquarters hotel.

A variety of entertainment is being planned by committees of the Metropolitan Section. Teas, tours, smokers, banquets, and luncheons will fill the schedule of the convention-goer. A full program of these events and the technical papers will be published in the December issue of CIVIL ENGINEERING.

MEMBERS OF METROPOLITAN SECTION meet at Engineers Club in New York to make initial plans for 1950 Annual Meeting of ASCE, to be held at Hotel Commodore, January 18-20. Shown (left to right, front row) are: Walter S. Douglas, Jr.; William S. LaLonde; John P. Riley, chairman of committee; Samuel Stickle; and Horace A. Vanderbeek. In same order back row are: Eugene Itjen; Jewell Garrelts; Ford Bartlett; Charles Zollman; Harold Levenson, president, Junior Branch; and Raymond Brandes. Other planning committee members absent when photo was taken are: William Griffin; Charles Molineaux, president, Metropolitan Section; Edward Cleary; and Edward Wininger.

Post-Convention Bermuda Tour

The post-convention tour to Bermuda, which was for many years a part of the ASCE Annual Meeting, has been resumed for the first time since World War II called a halt to all such activities. The luxury cruise ship, "Queen of Bermuda," which was built especially for the Bermuda run, has been completely reconditioned for its return to the pleasure excursion service.

The schedule for the post-convention tour, which has been arranged for the convenience of the Society, is coordinated with the meeting dates, permitting a stay in Bermuda of the better part of three days. The Queen, with the ASCE party aboard, will leave New York on January 21, at 3 p.m. Arrival in Hamilton will be early on the morning of January 23, and departure for the two-day return trip to New York late in the afternoon of the 25th.

Hotel headquarters in Bermuda will be the Princess, which overlooks the harbor. Stop-overs of any length may be easily arranged. The all-expense tour rates are from $180.30, including both United States and Bermuda taxes.

Make Tour Reservations Early

To assure reservations, choice of staterooms must be made before December 15. Full information about the cruise may be obtained direct from Mr. Leon V. Arnold, 36 Washington Square West, New York 11, N.Y. Mr. Arnold is the travel consultant who has been in charge of similar ASCE post-convention cruises in past years.

Engineers Invited to Submit Papers for Large Dams Conference

THE UNITED STATES Committee of the International Commission on Large Dams is soliciting a limited number of papers by engineers in the United States for submission to the Fourth International Conference on Large Dams in New Delhi, India, in 1951. Eminent dam designers and builders from all over the world are expected to attend the conference, which is being held as an activity of the World Power Conference.

Technical papers for the conference should be limited to one of the following subjects:

1. Method for determining the maximum flood discharge which may be expected at a dam and for which the dam should be designed. Selection of type and general arrangement of the temporary or permanent outlets and spillways and determination of their capacities.

2. Design and construction of earth or rockfill dams; corewalls and diaphragms of earth and rockfill dams.

3. Sedimentation in reservoirs and related problems.

4. Concrete for large dams.

Papers on other subjects of unusual interest may also be accepted at the option of the United States Committee. Interested engineers should communicate with the United States Committee on Large Dams through its chairman, Gail A. Hathaway, 4316 Van Buren Street, University Park, Hyattsville, Md.

In recent years the United States has been a leader in the construction of large dams. Projects now being planned in several foreign countries will present engineering problems comparable to those faced in the United States, and the experience of American engineers will doubtless be considered of value in the solution of these problems.

Committee Completes Plans for 1949 Fall Meeting of ASCE

FINAL DETAILS OF ASCE FALL MEETING, which will be in session in Washington, D.C., as this issue comes off the press, are being worked out by Society and Section officers and committee members. Shown (left to right, front row) are Daniel D. Walser, vice-chairman; A. N. Carter, general chairman; E. Lawrence Chandler, Assistant Secretary, ASCE; Mrs. Gail A. Hathaway, chairman of Women's Activities Committee; Byron Bird, president of District of Columbia Section; Clifford A. Betts, Entertainment; and Gail A. Hathaway, Technical Program. Pictured in back row, left to right, are S. E. Ridge, Transportation; Vincent B. Smith, Hotel and Registration; Don P. Reynolds, Assistant to the Secretary, ASCE; Theodore M. Schad, Student Activities; T. Ritchie Edmonston, Finance; Alfred C. Stiefel, Publicity; Frank L. Weaver and Daniel B. Ventres, chairman and vice-chairman of Reception Committee; and A. G. Fiedler, Excursions. A number of Fall Meeting technical papers are printed or abstracted in this issue. Others will be reviewed in the December number, which will carry an account of the Fall Meeting.

Material on Engineering as a Career Is Available

EACH YEAR NEARLY a thousand copies of "A Brief Bibliography on Engineering as a Career" are distributed free by the ASCE in response to requests from libraries, schools, guidance personnel, and individuals. The bibliography was begun about twelve years ago to facilitate replies to the many requests received at Society Headquarters for information on the subject. A new edition of this leaflet, providing additional references and an improved grouping of the material, is now available.

The list identifies five pamphlets and twelve books in the principal group, four books that are out of print, but available in many libraries, one pamphlet on Engineering Careers for Women, and five books of particular interest to guidance counselors. It also includes reference to the ECPD annual list of accredited undergraduate curricula, and to a comprehensive bibliography on all kinds of careers, including engineering.

The brief Bibliography makes no pretense at being all-inclusive, but it seems to serve its purpose adequately and has been included in at least one list of "the best bibliographies on careers." The Society will continue to distribute copies free of charge upon application to the Executive Secretary, 33 West 39th Street, New York 18, N. Y.

Tellers Canvass Second Ballot for 1950 ASCE Officers

October 17, 1949

To the Secretary of the
American Society of Civil Engineers:

The Tellers appointed to canvass the Second Ballot for Official Nominees report as follows:

For Vice-President, Zone I	
Albert Haertlein	1,719
Void	0
Total	1,719
For Vice-President, Zone IV	
Fred C. Scobey	2,514
Void	1
Total	2,515
For Director, District 3	
Carey H. Brown	127
Otto Holden	281
Void	4
Total	412
For Director, District 5	
Charles D. Curtiss	255
Frank L. Weaver	258
Void	0
Total	513
For Director, District 7	
Gordon H. Butler	501
Void	0
Total	501
For Director, District 8	
Louis R. Howson	445
Void	2
Total	447
For Director, District 9	
G. Brooks Earnest	513
Void	0
Total	513
For Director, District 12	
Walter J. Ryan	496
Void	0
Total	496
For Director, District 16	
Francis M. Dawson	369
George W. Lamb	468
Void	1
Total	838
Ballots canvassed	7,954
Ballots withheld from canvass:	
Without signatures	110
Total number of ballots received	8,064

Respectfully submitted,

EDWARD N. WHITNEY, *Chairman*
JAMES D. PARSONS, *Vice-Chairman*

George S. Bingham — R. Edward Kuhn
Charles C. Bonin — John H. Stamataky
Reuben Kosches — Paul M. Wentworth
Thomas R. Kuesel — Robert E. White

(*Tellers*)

William J. Wilgus, Honorary Member and Rail Expert, Dies

WILLIAM J. WILGUS, Honorary Member and former Director of ASCE, and a rail expert, died at his home in Claremont, N.H., on October 24, at the age of 83. Though his formal engineering education consisted of only a Cornell University correspondence course in drafting, he later was awarded honorary engineering doctorates by several universities in recognition of his achievements in railroad engineering.

In 1893, after early experience on Mid-Western railroads, Colonel Wilgus joined the staff of the New York Central and Hudson River Railroad as assistant engineer. As chief engineer and vice-president of the line from 1899 to 1907, he directed the construction of Grand Central Terminal, the change of motive power from steam to electricity, and improvements and extensions in the New York district. He also conceived the plan for the skyscraper development of the terminal area.

For papers on the New York Central improvements, published in the ASCE TRANSACTIONS, Colonel Wilgus was awarded the Thomas Fitch Rowland Prize in 1909 and the Arthur M. Wellington Prize in 1942. He also received the Telford Medal of the Institution of Civil Engineers of Great Britain for his service as chairman of the Advisory Board of Engineers on Construction of the Detroit River Tunnel, which developed the first use of the trench and tremie method of construction on that project.

Col. W. J. Wilgus, 1865–1949

As a consultant in private practice from 1908 to 1932, Colonel Wilgus served in many private and public service capacities. He initiated a move for creation of the Port of New York Authority, which built the Holland Tunnel. For his services as director of military railways and deputy director general of transportation in France during World War I, he was awarded the Distinguished Service Medal and the decoration of Officer of the Legion of Honor of France. He is credited with originating the Transportation Corps of the Army. In 1934 and 1935 he was director of the New York City Emergency Relief Administration.

Long active in the ASCE, Colonel Wilgus served as Director from 1902 to 1904, and he was a past-president of the Metropolitan Section. He was elected to honorary membership in the Society in 1935. Colonel Wilgus was also an honorary member of the American Institute of Architects; a charter member and former director of the American Institute of Consulting Engineers; and a charter member of the American Railway Engineering Association. Since 1924, when he established a home in Weathersfield, Vt., Colonel Wilgus had written a great deal on Vermont history. In 1933 he donated a 150-acre tract of land, along U. S. Route 5 in Weathersfield, known as "Wilgus State Forest Park," to the state to enable motorists to enjoy the Connecticut Valley scenery.

Past-President and Hon. M. Marston Dies in Motor Crash

ASCE PAST-PRESIDENT and Honorary Member Anson Marston, of Ames, Iowa, was killed in a motor crash on October 21. His age was 85. A veteran engineering educator, he had been dean emeritus of engineering at Iowa State College since his retirement from active academic life in 1932. Dean Marston served the ASCE in many capacities, having been Director from 1920 to 1922; Vice-President in 1923 and 1924; and President in 1929. He was elected to honorary membership in 1938.

He was educated at Berea College, Berea, Ky., and at Cornell University, from which he was graduated in 1889. In 1892, after a few years with the Missouri Pacific Railway, he joined the Iowa State College staff as professor of civil engineering and head of the department, and from 1904 until his retirement he was dean of engineering. In recognition of his contributions, the college in 1938 established the Marston Medal, which is awarded annually to an engineering alumnus of Iowa State for engineering achievement.

Anson Marston, 1864–1949

As a consulting engineer in practice from 1892 on, Dean Marston was engaged on the design and construction of water works, sewerage systems, and bridges throughout the Middle West. In 1904 he began a long association with the Iowa State Highway Commission, for which he was coordinator of transportation from 1934 to 1939. He served as major and lieutenant colonel of Engineers in World War I, and had the rank of colonel in the Reserve Corps for many years afterwards.

Dean Marston was author of almost 200 professional papers and technical reports, and co-author with the late T. R. Agg, his successor as dean, of a well known text on *Engineering Valuation*. A member of many professional societies, he had served as president of the Society for Promotion of Engineering Education (now the American Society for Engineering Education), the American Society for Testing Materials, and the Iowa Engineering Society. Honors accorded him include the Fuertes Gold Medal of Cornell University, the Chanute Medal of the Western Society of Engineers, and the Lamme Medal of the ASEE.

Mining Engineer Wins 1949 John Fritz Medal

THIS YEAR THE John Fritz Medal goes to Walter Hull Aldridge, a mining engineer and member of the American Institute of Mining and Metallurgical Engineers. President of the Texas Gulf Sulphur Co. for more than thirty years, Mr. Aldridge is cited as "engineer of mines and stateman of industry who by his rare technical and administrative skills has importantly augmented the mineral production of our country and Canada."

The John Fritz Medal, which was established in 1902 as a memorial to the engineer whose name it bears, is a joint award of the four Founder Societies "for scientific or industrial achievement" in any field of pure or applied science. The roster of John Fritz medalists includes many dis-

Walter Hull Aldridge

tinguished names—Alexander Graham Bell, Thomas Edison, Gen. George Goethals, M. ASCE, and ASCE Honorary Members Herbert Hoover and Charles Kettering, to mention a few.

Presentation of the medal to Mr. Aldridge will be made at a special dinner in his honor, held at the University Club in New York, on November 16, under the auspices of the AIME.

Hoover Medal Awarded to Frank B. Jewett

FRANK B. JEWETT, member and past-president of the American Institute of Electrical Engineers, is the eleventh winner of the Hoover Medal, joint award of the four Founder Societies "for distinguished public service." The medal, considered one of the outstanding honors of the engineering profession, was instituted in 1930 in honor of Herbert Hoover, Hon. M. ASCE, who was the first recipient

Dr. Frank B. Jewett

of the medal. Other distinguished Hoover medalists include Ambrose Swasey, John F. Stevens, and Gano Dunn, all Honorary Members of ASCE, and Past-President Malcolm Pirnie.

A resident of Short Hills, N.J., Dr. Jewett has had a long career with the American Telephone and Telegraph Co., which he served as vice-president in charge of development and research from 1925 to 1944. He has also been president of the Bell Telephone Laboratory, and formerly was president of the National Academy of Sciences. Dr. Jewett has been active on the board of Engineering Foundation, which he has served as vice-president, and is holder of the John Fritz Medal, the Washington Award, and other honors.

Presentation of the Hoover Medal to him will be made during the winter meeting of the AIEE, to be held in New York January 30 to February 3.

Salary Plan for Government of Puerto Rico Published

JUST PUBLISHED IS a report of a Society-sponsored evaluation of the job classification and allocation systems in use by the Office of Personnel, Government of Puerto Rico. The study was made at the request of former Governor Pinero and was performed by a member of the Society Headquarters staff, Allen P. Richmond, Jr., who made three trips to Puerto Rico during the winter and spring of 1948–1949. Progress was reported in the April issue of CIVIL ENGINEERING.

The study was confined to an evaluation of existing job specifications for engineering and closely allied positions, and to testing and recommending a more systematic allocation procedure than the one then in use.

Specific allocations were made of a number of typical engineering positions. The study did not include salary rates, but recommendations were made in the report that a community study be instituted to furnish authoritative data on prevailing rates of pay for engineering services in that area, with which the government must compete to retain present personnel and attract new employees. Detailed step-by-step suggestions for conducting a salary survey are included in a four-page exhibit which is part of the report.

The point-evaluation method of job analysis developed by Southern California Aircraft Industry was used successfully in the field studies, and demonstrated the value of a systematic job evaluation system of this type. Its particular value lies in the fact that it can resolve problems of borderline allocation, one of the principal concerns of personnel officers and the Board of Appeals.

Publication of this report concluded the eighth study of engineering positions or salaries performed under Society auspices at the request of public agencies.

New Volume of Society "Transactions" Distributed

ANOTHER RECORD OF technical progress in the civil engineering field is available, with the issuance of Volume 114 of ASCE TRANSACTIONS. Outstanding among the many valuable papers in the current volume is the group on the proposed Panama Canal changes, which fill a quarter of the 1,400-page volume. The other papers represent practically the entire professional fields—city planning, structural design, hydro-plant operation, geodesy and triangulation, dams, piles, industrial waste, retaining walls, valuation, suspension bridges, highway bridge decks, expansion joints, and wind action, to mention a few.

For the first time in the Society's 83-year history of printing, memoirs of deceased members are omitted, with a consequent decrease of several hundred pages in the over-all size of the volume. Brief obituaries in CIVIL ENGINEERING are now substituted for the memoirs.

Schedules call for mailing the cloth and paper-bound volumes in October, and the leather-bound edition in November. Those who do not already have standing orders for TRANSACTIONS should notify ASCE Headquarters of the type of binding desired. The cost will be charged to the member's account: $2.00 for the paper volume; $3.00 for the cloth; and $4.00 for the leather binding. For general sale, the corresponding prices are $16, $17, and $18 a volume.

First Member Claim Paid in Group Disability Plan

FIRST TO BENEFIT in the Society's group plan of disability insurance, announced in the June and August issues of CIVIL ENGINEERING, is a member of the North Carolina Section, who recently received a check for $185.71 from the Continental Casualty Co., of Washington, insurance underwriters for the Society's plan. The check covers the insurance for a period of three weeks and five days at the rate of $50 per week (Plan A) during which the member was hospitalized and unable to work.

Though the group plan of insurance is still under consideration by members in Local Sections, several hundred members have already placed themselves in line to receive the benefits of the plan by sending applications to the insurance underwriters.

members will have had a chance not only of government here as it affects the engi- development. Dependability, organiza-

NOTES FROM THE *Capital*

Joseph H. Ehlers, M. ASCE
Field Representative, ASCE

Funds Appropriated for Advance Planning

IMPORTANT CHANGES TOOK place in the status of legislation of interest to engineers in the final days of Congress prior to its winding up for the year. Of particular interest is the final passage of the legislation providing funds for the advance planning of non-federal public works (Public Law 352—81st Congress). The law authorizes the Administrator of General Services to make loans without interest to non-federal public bodies for the purpose of planning needed public works. Apparently not fully satisfied with the administration of the previous advance planning bill, two amendments emphasize that the advances must be used for planning projects which will actually be built. The amendments follow:

"If the construction of the public works is not undertaken or started within three years after the full amount of the loan or advance thereof has been made and the Administrator of General Services shall determine (which determination shall be conclusive), after due notice and hearing, that the public agency has not acted in good faith either in obtaining the loan or advance or in failing to undertake or start the construction of such public works, the Administrator shall demand prompt payment of such loan or advance.

"In the event the loan or advance shall not have been repaid within said three-year period, such public agency shall not be eligible to apply for loans or advances on any other public works."

This legislation was passed with considerable difficulty and only under a suspension of the Rules following the refusal of the Rules Committee to give clearance to the bill.

It was obvious that Congress desired to avoid any possibility of another WPA program for lack of planned undertakings in view of the recent increase in unemployment; and on the other hand will not tolerate expansive plans which will not be carried out and which are beyond the ability of the local public body to pay for.

Although P.L. 352 authorized the sum of $100 million to be appropriated and the Bureau of the Budget requested a current appropriation of $12 million with additional contract authorizations of $25 million, the House Appropriations Committee cut these figures to $8 million plus an additional $17 million in contract authorizations for the current fiscal year.

Alaska Gets Funds for Public Works

The Alaska Public Works Act (P.L. 264—81st Congress), as reported last month, provides for federal participation in the construction cost of local public works in Alaska. In the closing hours of the session, Congress passed an appropriation for the current fiscal year of $1 million plus an additional $4 million of contract authorizations. In view of the impending winter season, this appears to be adequate to get the program started. The engagement of engineers and architects will be by the federal government. It may be noted that, under the advance planning programs of recent years, over $8 million worth of projects have already been designed. These already planned projects will probably constitute the bulk of the jobs for the first year's construction. Construction contracts will be let by the federal government and the finished structures will be sold to the local public bodies so as to provide an average reimbursement of 50 percent of the cost.

In connection with the advance planning programs for federal buildings, $12 million was appropriated for acquisition of sites and preparation of plans. An additional $10 million was appropriated for renovation and improvements.

Science Foundation and Point 4 Held Over

The National Science Foundation legislation was prevented from being brought up by the press of business in the last days of the session. This legislation will undoubtedly come up after Congress reconvenes and the EJC Panel will continue its efforts in support of this legislation.

The President's Point 4 Program for technical aid to "assist the people of economically underdeveloped countries to raise their standard of living" never got beyond the committee stage but will undoubtedly receive much attention when Congress reconvenes in January.

TOTAL MEMBERSHIP AS OF OCTOBER 9, 1949

Members	7,464
Associate Members	9,565
Corporate Members	17,029
Honorary Members	40
Juniors	9,682
Affiliates	73
Fellows	1
Total	26,825
(October 9, 1948	24,068)

Over Half Billion Available for Flood Control Construction

While the omnibus Rivers and Harbors and Flood Control Bill (H.R. 5472) which would authorize new projects, was deferred for consideration in January, the Army Civil Functions Appropriation Act (P.L. 355) appropriated well over half a billion dollars for construction of navigation and flood control works. An item on page 71 amplifies the Army appropriation.

Congress Approves Salary Increases

In the last days of the session, Congress passed the legislation providing for salary increases of department heads (P.L. 359) and the revisions of the Classification Act. The former provides for large increases in the salaries of some 200 top government officials. The Classification Act provides for moderate salary increases for the nearly 900,000 classified employees and sets up a new system of classification replacing the old CAF (clerical, administrative, and fiscal) and P (professional) grades. Firm assurance has been given that this change in the classification system will not affect professional employees adversely. However, the statutory basis for their protection is removed and the Civil Service Commission will be responsible for protecting their status. The Engineers Joint Council Committee on Engineers in the Civil Service feels that under the new act considerable vigilance will have to be exercised by our members to prevent the encroachment of unqualified employees into professional positions. Its view that engineering activities ought to be administered by engineers may run counter to the views of some agencies in setting up jobs pertaining to engineering administration under the new law. This matter will be discussed further as new developments take place.

Earlier in the month Congress approved pay increases for the armed services which by signature of the President became effective November 1.

Government Matches State Airport Funds

Under a bill passed by both Houses on the last day of the 81st Congress $14\frac{1}{2}$ million plus $36 million in contract authorizations until June 1953 would be made available to be matched by state money for rural and city airports during this fiscal year. Federal funds going to the states would include unused allotments made during previous years.

Fall Meeting Convenes

Before this column appears in print, the Washington Fall Meeting will have taken place and it is hoped that many

ing, will take place in the Mechanical

nounced his retirement as special assistant

meeting. Mr. Roberts advocated in-

members will have had a chance not only to see at first hand the physical development of the Nation's Capital but also to get an added insight into the conduct of government here as it affects the engineering profession.

Washington, D.C.
October 20, 1949

Junior Branch of Metropolitan Section Sponsors Lectures on Prestressed Concrete

PRACTICAL APPLICATIONS OF the theory of prestressed concrete were graphically described by Prof. Gustave Magnel, director of the reinforced concrete laboratory at the University of Ghent, in a recent lecture sponsored by the Junior Branch of the Metropolitan Section and the Columbia University Civil Engineering Department. An audience of almost 300 heard Professor Magnel, one of the foremost designers of prestressed concrete structures and author of a recent authoritative book on the subject.

PROF. GUSTAVE MAGNEL speaks on practical applications of prestressed concrete theory at meeting under joint auspices of Junior Branch of Metropolitan Section and Columbia University Civil Engineering Department.

After explaining the fundamentals of prestressing, Professor Magnel showed slides of recent European buildings and bridges employing the prestressed principle. These structures included various buildings in Belgium and Holland and a two-span continuous highway bridge over the Meuse at Sclayn, Belgium, with each span over 200 ft. Use of prestressed concrete in these structures proved 20 percent cheaper than steel structures would have been and 10 percent cheaper than reinforced concrete, Professor Magnel stated, asserting that the greatest saving in the prestressing process is attributable to the prefabrication, which permits use of the steel forms over and over. Great savings in labor are also made possible by use of the method, Dr. Magnel pointed out, referring for illustration to construction of a 9-acre warehouse, on which no more than 70 men were employed at any one time.

Dr. Magnel was introduced to his audience by Charles Zollman, of the Pre-Load Corp., which is sponsoring his tour in this country. Curzon Dobell, vice-president and general manager of the Pre-Load Corp., also spoke briefly on the Walnut Lane Bridge in Philadelphia, the first prestressed concrete bridge to be built in this country. A dinner for about thirty, including the ASCE Headquarters staff, at the Columbia University Men's Faculty Club preceded the lecture.

Council on Reinforced Concrete Research Meets

THE COUNCIL ON Research in Reinforced Concrete, which was formed last year by the Engineering Foundation to conduct research projects in reinforced concrete "considered necessary to place methods of design on a more rational basis," recently held its first meeting in Chicago. Plans were discussed for the future work of the Council, and a report on a project now under way at the University of Illinois was received. The latter program involves testing 120 reinforced concrete columns under varying eccentricities of load. Strains will be measured in the concrete and steel, and the analysis will attempt to correlate the results with existing proposed ultimate theories for concrete.

Chairman of the Council is Robert F. Blanks, M. ASCE, director of research for the Bureau of Reclamation.

ECPD Assesses Engineers' Qualifications for Work

INTELLIGENCE IS THE most highly sought after personal quality in an engineering employee in the opinion of 44 leading engineering executives, who participated in a survey recently conducted by the Engineers Council for Professional Development to provide facts about personality traits that would be valuable in its program of student and professional development. Dependability, organizational acceptability, energy, and emotional acceptability were rated in the order given as other desirable characteristics.

The results of the three-year survey, which also included opinions of college administrators, faculty, personnel officials, and engineering students, have been made available by ECPD in a 25-page booklet, entitled *The Most Desirable Personal Characteristics*. Copies may be obtained from ECPD, 29 West 39th Street, New York 18, N.Y., at 25 cents each.

NEWS OF LOCAL SECTIONS

Coming Events

Arizona—Annual fall meeting in Phoenix, November 18 and 19. The program will include an open forum for engineers and architects Friday night, a joint luncheon with the Arizona Association of Engineers Saturday noon, and a joint dinner dance Saturday night.

Buffalo—Luncheon meeting in the Buffalo Athletic Club, November 16, at 12:15 p.m.

Colorado—Meeting in the Auditorium Hotel, Denver, November 14, at 6:30 p.m.

Connecticut—Dinner meeting at Ceriani's Restaurant, New Haven, November 7, at 6:30 p.m.

District of Columbia—Meeting in the Cosmos Club Auditorium, Washington, D.C., November 29, at 8 p.m., featuring election of officers.

Duluth—Luncheon meeting in the Kitchi Gammi Club, Duluth, November 21, at 12:15 p.m.

Hawaii—Meeting in Honolulu on November 9.

Iowa—Afternoon meeting at the Fort Des Moines Hotel, Des Moines, November 17, beginning at 3:30 p.m.

Kansas—Meeting in Topeka on November 18.

Los Angeles—Annual ladies' night dinner dance at the Hollywood Roosevelt Hotel, Hollywood, December 2, at 7:30 p.m. A seminar sponsored by ASME and AIEE, with ASCE cooperat-

ing, will take place in the Mechanical Engineering Building of the California Institute of Technology, Pasadena, November 16, at 7:30 p.m. Regular technical meeting of section on November 9.

Louisiana—Meeting at the St. Charles Hotel, New Orleans, on November 28.

Maryland—Meeting in the Engineers Club, Baltimore, November 9, at 8 p.m., preceded by cocktails at 6 p.m., and dinner at 7 p.m.

Metropolitan—Meeting in the Engineering Societies Building, November 16, at 8 p.m.

Michigan—Dinner meeting in the Engineering Society of Detroit, Detroit, on November 3; dinner at 6:30 p.m., and meeting at 8 p.m.

Northeastern—Joint meeting with Boston Society of Civil Engineers and civil engineering students of Northeastern University on the campus, Boston, November 9, at 6 p.m.

Philadelphia—Meeting in the Engineers Club, Philadelphia, on November 8.

Pittsburgh—Joint meeting with the Civil Section of the Engineers' Society of Western Pennsylvania, in the Chamber of Commerce Auditorium, Pittsburgh, November 15, at 8 p.m. Juniors of the Section are sponsoring a square dance at Rose Barn, North Park, on November 18.

Rochester—Joint luncheon meetings with the Rochester Engineering Society on November 22, November 29, and December 6.

Sacramento—Regular luncheon meetings in the Elks Club, Sacramento, every Tuesday, at 12:30 p.m.

Tennessee Valley—The Oak Ridge Sub-Section will be host to the fall meeting of the Tennessee Valley Section at the Oak Terrace, Oak Ridge, on November 18 and 19. The meeting will feature technical sessions, inspection trips, and social events.

Virginia—Joint meeting with the Engineers Club of Hampton Roads, at the Pythian Castle, Norfolk, November 18, at 8 p.m.

Wisconsin—Meeting in the Engineering Society of Milwaukee, November 17.

Recent Activities

BUFFALO

MEMBERS OF THE Section paid tribute to ASCE Director Harland C. Woods at a recent testimonial luncheon in the Buffalo Athletic Club. Colonel Woods, an authority on Niagara power and Great Lakes waterways and harbors, recently announced his retirement as special assistant to the district engineer, U.S. Corps of Engineers (October issue, page 48). His activities were praised in short talks by District Engineer Frank H. Forney, Newell L. Nussbaumer, Edward J. Nunan, and former ASCE Director and Vice-President Edward P. Lupfer.

LOS ANGELES

ADVANTAGES OF THE Monorail Rapid Transit System were explained by George D. Roberts, president of the Pacific Monorail Systems, at a recent Section meeting. Mr. Roberts advocated installation of the system in Los Angeles as a solution to the city's rapid-transit problem. During the evening ASCE President Franklin Thomas reported the highlights of the Summer Convention in Mexico City, supplementing his talk with kodachrome slides.

A talk on the master plan for beach development for Southern California was given by A. G. Johnson, of Beach Erosion Control for the City of Los Angeles, at a meeting of the Junior Forum preceding the regular Section meeting.

DISTRICT OF COLUMBIA

RECONSTRUCTION WORK on the Capitol was recently inspected by a large group of District of Columbia members. The inspection, which included tours of both the House and Senate wings, was arranged through the courtesy of David Lynn, Architect of the Capitol. Before the tour Lewis C. Prell, superintendent of construction in Mr. Lynn's office, briefed the group on the background of the work and previous repair projects. The current project, which includes reroofing the Senate and House Chambers, was then described by James M. Gongwer, partner in the firm of Marshall & Gongwer, consulting engineers on the structural work. The cast-iron trusses in the roof are being replaced by structural steel, and a new roof built of lightweight concrete covered with copper. Around $5,000,000 was appropriated for the project, which is scheduled for completion by December 15 of this year. About 140 members and guests of the Section made the trip.

CAPITOL RECONSTRUCTION PROJECT is studied by members and guests of District of Columbia Section during recent inspection tour.

COLORADO

GEOLOGICAL ASPECTS OF engineering work were discussed at a recent dinner meeting of the Colorado Section by Roger Rhoades, chief geologist, Branch of Design and Construction, U.S. Bureau of Reclamation. Mr. Rhoades' talk, which was illustrated by numerous slides, covered engineering problems encountered in work on expansive clays under foundations, in landslides, and in foundations under dams. Two of the local Technical Divisions, recently formed by the Colorado Section, have elected officers. Robert Sailer will be chairman for the Structural Division; Bruce Johnson, vice-chairman; and Hugh Hemple, secretary. The Hydraulics Division officers are Herbert E. Prater, chairman; Sheldon H. Streater, vice-chairman; and Carl Wilder, secretary.

DULUTH

SOCIETY NEWS DISCUSSED during a recent meeting of the Duluth Section included the proposal for amending the ASCE constitution and the projected plan for group insurance. The technical program consisted of an illustrated talk by Paul Sramek, of Meadowlands, Minn., on a recent trip to Czechoslovakia.

KANSAS CITY

THE INTERNATIONAL ASPECT of most problems today necessitates a wide general knowledge, Robert Mortvedt, vice-president of the University of Kansas City, told members of the Kansas City Section in the feature talk at the Section's first fall meeting. A liberal education, in his opinion, will give students the background to live successfully. Recalling statements made by Dr. Clarence R. Decker, president of the university, who recently returned from a 33,000-mile trip around the world, Dr. Mortvedt cautioned that Americans can no longer be concerned only with what occurs in this country. The proposed revision of the Society's constitution and the group insurance plan were discussed during the business meeting.

MIAMI

ENGINEERING PROBLEMS INVOLVED in constructing routes and channels through the Everglades were outlined at the October meeting by Charles W. Brookfield, Florida representative of the National Audubon Society. Mr. Brookfield also described the unusual birds and interesting foliage to be found in the area. During the business session, ASCE Director Edmund Friedman discussed the District 10 Conference of Local Sections, held at Chattanooga during the summer, and explained the advance in Society and Section functioning represented by such conferences.

NORTHWESTERN

IN A TALK on Upper Harbor developments in Minneapolis, given at the October meeting of the Northwestern Section, Col. L. G. Yoder, district engineer for the St. Paul office of the Corps of Engineers, covered the financing, construction procedures, engineering problems, and benefits of the project. During the business session, a motion was carried to renew the $200 scholarship given annually by the Section to a senior civil engineering student at the University of Minnesota.

PHILADELPHIA

"PUBLIC WORKS CONSTRUCTION in Philadelphia" was the theme of the Section's first meeting of the fall season, which was preceded by inspection of the Walnut Lane and Penrose Avenue bridges now under construction and rigid frame steel hangars recently completed at the International Airport. Speakers in the symposium were Thomas Buckley, director of public works, who reviewed the city's public works program; Elwyn E. Seelye, New York City consultant, whose subject was "Underpinning the Municipal Stadium"; Alexander Maltman, associate engineer of design for the Philadelphia Bureau of Engineering, Surveys, and Zoning, who described the design of the hangars viewed during the afternoon inspection; Max Barofsky, principal assistant engineer of construction for the Bureau, who discussed construction problems involved in the Caster Avenue Bridge and Frankford Creek realignment; and Samuel S. Baxter, assistant chief engineer for the Bureau, who gave a "Pictorial Presentation of Public Works Projects in Philadelphia."

ST. LOUIS

INSPECTION OF THE Missouri Portland Cement Company's new St. Louis plant launched the Section's fall program. The tour of the plant was preceded by a luncheon meeting, at which L. A. Wagner, director of engineering and research for the Portland Cement Co., reviewed the history of portland cement, describing particularly the development of rotary kilns. The ever-increasing cost of fuel, he said, makes it necessary to build kilns increasingly longer, since by extending the length of the kilns it is possible to extract more heat from the kiln gases before they are released to the stack. Thus the two kilns under construction in the St. Louis plant are 450 ft long by 11 ft 3 in. in diameter, in contrast to the first kilns installed in the plant in 1903, which were only 60 ft long. At the conclusion of Mr. Wagner's talk the group visited the Material Handling and Finish Grinding Buildings of the new plant, which are completely finished. Of special interest were the dust collectors, automatic lubrication systems, and other devices designed to make the manufacturing process cleaner and more orderly than is usually possible in cement making.

PITTSBURGH

DIFFICULTIES INVOLVED IN the construction of offshore oil drilling installations in the Gulf of Mexico were demonstrated at a recent meeting by colored motion pictures, shown and explained by Paul G. Benedum, president of the Hiawatha Oil & Gas Co. There was an attendance of about 100 at the meeting, which was a joint session with the Civil Section of the Engineers' Society of Western Pennsylvania. On October 8 the Section sponsored an inspection trip to Lock No. 5 on the Monongahela River at Brownsville, Pa., where Prepakt concrete is being used for resurfacing the lock walls. At a luncheon meeting following inspection of the project, B. D. Keatts, of Intrusion-Prepakt, Inc., discussed the work and showed slides illustrating other uses of the prepakt-intrusion method.

SACRAMENTO

IMPROVEMENTS BEING MADE by the Western Pacific Railroad Co. were discussed at a recent Sacramento Section luncheon meeting by H. C. Munson, vice-president and general manager of the Western Pacific. These improvements include centralized traffic control and installation of Diesel locomotives. At another recent luncheon meeting A. G. Mott, past-president of the Section spoke on "Valuation of Public Utility Systems." A description of the functioning of the Sacramento city government by City Manager B. W. Cavanaugh comprised the technical program at another meeting. Edwin F. Sullivan has been chosen president of the Section to fill the unexpired term of the late Fred H. Paget (obituary on page 86).

SEATTLE

FROM AN ENGINEERING standpoint, the projected geological survey of the Seattle area will be helpful in finding solutions to landslide, tunneling, and foundation problems, J. Hoover Mackin, professor of geology at the University of Washington, told members of the Section at a recent meeting. Speaking on the "Glacial Geology of the Seattle Area," Professor Mackin traced the geological history of the state and emphasized the importance of studying the clay, hardpan, and other deposits that have been laid down in millions of years of geological history as a clue to prevailing conditions. The present survey of the Seattle area is being conducted on a limited scale, and additional funds are necessary for completing the work.

TRI-CITY

THE TRI-CITY SECTION was one of eight technical groups sponsoring the program of the third annual fall dinner meeting of the Quad-City Technical Council held recently in Davenport, Iowa. Walter L. Lawrence, of the promotion department of the Radio Corporation of America, was the principal speaker in a program devoted to "Television—Its Mechanism and Promise." Addressing an audience of 600, Mr. Lawrence, predicted a far-reaching development of the medium, and stated that within a decade, after its full commercialization, it may increase the demand for goods and services by as much as 10 percent.

COMMITTEE CONSISTING OF A. F. Burleigh, president of Tri-City Section (left), B. D. Kent, program chairman, Industrial Safety Engineers Association of the Quad Cities (center), and L. W. Andrews, president of Quad City Radio Technicians Association, plan details of third annual meeting of Quad-City Technical Council. Tri-City Section was one of eight technical groups participating.

SAN DIEGO

DESIGN AND CONSTRUCTION problems arising in connection with the Coachella Valley Project, now under construction near Indio, Calif., were outlined by William Bryant, former design engineer for the Bureau of Reclamation, in a leading talk at a recent dinner meeting. Phil Helsley, chairman of the Section's Legislative Committee, gave a report on recent state legislation affecting the profession.

SAN FRANCISCO

PROBLEMS CONNECTED WITH the removal of plutonium from liquid wastes by the activated-sludge method were covered at the Section's October meeting by John F. Newell, project sanitary engineer for the Atomic Energy Commission at Los Alamos, N. Mex. Mr. Newell described his experiences encountered in experiments with radioactive particles having half lives of from a fraction of a second to many thousands of years. The Section recently made a weekend field trip to the Pacific Gas & Electric Company's $68,000,000 construction project on the Feather River north of San Francisco. Structures viewed included both Cresta and Rock Creek dams, powerhouses, and tunnels.

SPOKANE

THE ASCE BUDGET, publications, and other matters recently before the Board of Direction for discussion were covered in a talk on the Summer Convention in Mexico City, given by ASCE Director W. L. Malony at a recent meeting. Mr. Malony also commented on the problems of the engineer in Mexico. Much of the meeting was devoted to business discussion and to making program plans for the fall.

TENNESSEE VALLEY

DETAILS OF THE new K-29 atomic energy project, recently begun at Oak Ridge, Tenn., were revealed by Robert Somers, of the U.S. Atomic Energy Commission, in a talk at a recent meeting of the Oak Ridge Sub-Section. The project, which is estimated to cost over $66,500,000, will substantially increase the production of U-235, from which atomic bombs are made. Work began in August of this year, and is scheduled for completion by the end of June 1951. The construction program at the Oak Ridge National Laboratory was outlined at the October meeting by K. C. Brooks, of the Atomic Energy Commission. Originally called the Clinton Laboratory, the Oak Ridge Laboratory was completed in 1944 as a pilot plant for the production of critical materials. Some $18,000,000 is to be spent on the new construction program.

Problems arising in the disposal of radioactive waste were discussed at a dinner meeting of the Chattanooga Sub-Section by Roy J. Morton, head of the Waste Disposal Research Section of the Oak Ridge National Laboratory. Areas of further research were indicated in the enthusiastic question-and-answer period that followed his talk.

TEXAS

RECENT CONSTRUCTION TRENDS in the United States were outlined at a luncheon meeting of the Fort Worth Branch by Jack Singleton, chief engineer of the American Institute of Steel Construction. Much of the meeting was devoted to business discussion.

VENEZUELA

MONTHLY PROGRAMS, ALTERNATING talks in English and Spanish, are being featured by the newly formed Venezuelan Section of the Society. Thomas Hay, superintendent of the Racine, Wis., sewage treatment plant, and consultant to the Chain Belt Co., recently addressed the group in English on the San Tome sewage treatment plant. At another meeting, irrigation in the valley basin of Valencia was discussed in a symposium, presented in Spanish, by Dr. Pedro Palacios, director of the Department of Irrigation of the Venezuelan Ministry of Public Works, and Dr. Fernando Key, of the Irrigation Department.

WEST VIRGINIA

RECENT INSPECTION OF the Philip Sporn Station of the American Gas & Electric System's plant near New Haven, W.Va., was followed by a dinner meeting and technical program. R. G. Skinner, director of public relations for the Appalachian Electric Power Co., of Charleston, detailed the plans of the American Gas & Electric System for future power development. Representatives of the company, who had assisted at the afternoon inspection trip, were then introduced to the group and spoke briefly. These included D. W. Parsons, general superintendent on the construction of the plant; W. H. Graves, power transmission specialist; and H. R. Andrews, who will be in charge of operation of the plant. New Section officers are Frank D. McEnteer, president; Russell C. Quinn and R. V. Engstrom, vice-presidents; and Kenath A. Kettle, secretary-treasurer.

WISCONSIN

A RECENT SECTION inspection trip to the Milwaukee water filtration plant was headed by James E. Kerslake, superintendent of the plant. Following the tour of inspection, Mr. Kerslake was guest of honor at a Section dinner and principal speaker at the evening technical meeting. He touched on the importance of the plant, the technical experience gained in its operation, and its efficiency in supplying the city with an unusually fine grade of water. During the business meeting, the proposed change in the ASCE constitution was discussed.

NEWS BRIEFS

Need for More Public Works Termed Essential at Annual APWA Congress

INCREASED CONSTRUCTION OF public works was seen not only as a safeguard against recession but also as "a vital function necessary to our economy and way of life" by James W. Follin, M. ASCE, acting deputy administrator of the General Services Administration, in a talk given before the recent 55th annual Public Works Congress of the American Public Works Association in Kansas City. Expressing the federal viewpoint in a panel discussion on the why of long-range public works planning, Mr. Follin emphasized the fact that if planning is put off until construction is imperative, limited time may make the approach inadequate. This is not an efficient approach, he said, and it is a costly one. In the event of war, such security measures as the dispersion of plant and people would "create tremendous new public works problems and require extensive long-range planning before any moves could be made," he pointed out.

Mr. Follin endorsed President Truman's plea, in his Mid-Year Economic Report to Congress, for a rapid expansion of our public works reserve as a "safeguard if public works should have to be accelerated," and his recommendation for the channeling of construction and procurement into areas of high labor surplus. Stressing the relationship between public works and the national economy, Mr. Follin declared that, "Public construction is much more important than its percentage relationship to the national income might indicate. Public construction provides a considerable volume of employment at the site."

In discussing the position of the state in long-range planning, Alvin Pasarew, Assoc. M. ASCE, director of the Maryland State Planning Commission, outlined three functions of states in planning public works. These include development and review of all departmental programs, coordination of highway and airport plans, and integration of local projects of regional concern, such as schools, hospitals, libraries, housing facilities, and water works.

Other ASCE members appearing on the four-day program included Henry W. Taylor, New York City consultant, who outlined methods of financing refuse disposal; E. L. Knebes, assistant city engineer of Milwaukee, Wis., who evaluated municipal, state, and federal relationships in disaster relief; George W. Barton, engineering director of Associated Consultants, Evanston, Ill, who discussed financing as the crux of the parking problem; D. Grant Mickle, director of the engineering division of the Automotive Safety Foundation, Washington, D.C., who advocated all-inclusive studies of traffic as a long-range solution to the traffic problem; and Lewis M. Wrenn, director of public works of Pontiac, Mich., who discussed public works employees as key personnel in a city's public relations program.

W. O. JONES, M. ASCE, CITY MANAGER OF FORT WORTH, TEX. (left), is congratulated upon his election as president of American Public Works Association by outgoing president William A. Xanten superintendent of Washington, D.C., Division of Sanitation, at closing business session of recent 55th annual Public Works Congress, held in Kansas City, Mo.

Of much interest to the 800 engineers and public works officials attending the congress were displays shown by various government agencies, armed services groups, and manufacturers in connection with the annual Equipment Show. These included a joint Bureau of Reclamation and Corps of Engineers display indicating current and projected flood control and river development projects.

W. O. Jones, M. ASCE, city manager of Fort Worth, Tex., was elected president of the organization during the closing business session. Vice-presidents will be William S. Foster, Assoc. M. ASCE, engineering editor of *American City Magazine*, New York City, who will serve the Eastern area, and Carl Froerer, city manager of Alameda, Calif., who was named Western vice-president. ASCE members E. J. Cleary, Cincinnati, Ohio; Sol Ellenson, Newport News, Va.; and George R. Thompson, Detroit, Mich., were elected directors for a one-year term.

Contracts for York River Bridge Project Awarded

ANNOUNCEMENT OF THE award of two contracts totaling $7,114,943 for construction of a 3,750-ft double-leaf swing-span bridge across the York River at Yorktown, Va., has been made by the Virginia State Highway Commission. A $4,690,232 contract for building the substructure of the bridge went to the Massman Construction Co., and the Kansas City Bridge Co., of Kansas City, Mo. The Virginia Bridge Co., of Roanoke, received a $2,424,711 contract for building the superstructure.

About two and a half years will be required for construction of the bridge, which will be the largest of its type in the world and the largest ever built by the Virginia Highway Commission from the standpoint of both construction quantities and cost. The total cost of the bridge and its approaches will be more than $9,000,000. Plans for the structure were prepared by the New York City engineering firm of Parsons, Brinckerhoff, Hall & MacDonald.

British Builders Praise U.S. Construction Methods

UNITED STATES BUILDING efficiency makes labor here 50 percent more productive than in Great Britain, according to a report of the 17-man team of British builders, which recently completed a six-week study of construction methods in the United States. This efficiency is attributed largely to design, managerial direction, preconstruction planning, organization of the work at the job-site, mechanization, adequate supply of materials, and "in the outlook of each individual member of the building team, all tending towards greater efficiency, greater speed, and lower costs."

Among technical improvements and materials that impressed the British team, the report lists the extensive use of cinder blocks as backing for exterior walls of brick; use of asphalt shingles for roofing; use of ready-mixed concrete delivered to the job-site in trucks; and minimum use of scaffolding. Use of machinery at the job to cut and shape materials is also cited as representing "a saving in labor and transportation costs."

The British tour of American construction methods was sponsored by the Anglo-American Council on Productivity in cooperation with the Technical Assistance Division of the Economic Cooperation Administration. Other cooperating organizations were the Associated General Contractors of America and the American Institute of Architects, joint hosts to the group during its stay in Washington.

Contracts Let for Idaho Atomic Energy Project

WORK ON THE new atomic energy project near Arco, Idaho, will soon get under way with the award of several initial contracts, according to a recent announcement from the Idaho Operations Office of the Atomic Energy Commission. The largest single job to be started in the next six months will be the structure to house the Experimental Breeder Reactor being built by the Argonne National Laboratory in Chicago. A contract for the engineering work for the building itself, special equipment, and the reactor auxiliaries has been let to the Austin Co., of Cleveland. Bids will be asked this fall for work on an access road, utilities, excavation, and structural steel at a total estimated cost of $250,000, the AEC states.

Tentative plans are being made for construction of a Materials Testing Reactor, which will cost approximately $20,000,000. An initial cost-plus-fixed-fee contract, estimated at $1,870,000, for the engineering design of this reactor has been awarded to the Chemical Plants Division of the Blaw-Knox Construction Co., Pittsburgh. Completed plans will be due late in 1950.

About $6,000,000 worth of construction will be started this year in a series of comparatively small jobs, according to L. E. Johnston, manager of the Idaho Operations Office of the AEC. Ultimate expenditure of half a billion dollars on the Arco plant, which will consist largely of a series of atomic reactors to be used for testing uses of atomic energy, is planned.

Army Engineers Receive 1950 Civil Works Appropriation

CONGRESS HAS APPROPRIATED $635,428,190 for the civil works operations of the Corps of Engineers in 1950, according to an announcement from Maj. Gen. Lewis A. Pick, Chief of Engineers. These funds, a slight rise over the 1949 appropriation of $615,542,200, will permit continued postwar acceleration of the federal program for flood control and for improvement of the rivers and harbors of the country, General Pick states.

Much of the new appropriation, or $437,430,400, has been designated for flood control, with $366,330,400 going for the nationwide general program. This general flood-control appropriation will provide funds for 165 projects in 37 states. The flood control project for the Mississippi River and its tributaries receives $67,000,000, and the Sacramento Project, in California, $3,600,000. The Mississippi River Project extends over portions of seven states.

The program for improving the rivers and harbors of the country has been granted a total of $197,985,690. Included in this program are river and harbor construction projects in 34 states, the District of Columbia, and Alaska.

Planning funds are provided for 53 flood control projects, in 22 states and Hawaii, and for 16 river and harbor projects, in 10 states.

Construction in September Maintains Level of a Year Ago

WITH NEW BUILDING put in place in September totaling $1.9 billion, construction for the month reached a seasonal peak at about the same level as last year, the Department of Commerce reports. The September figure was only fractionally above the total for August, and the outstanding development in the construction situation was a contra-seasonal advance in private home building.

According to joint estimates of the Departments of Commerce and Labor, private residential building, exclusive of farm dwellings, reached a total of $680 million for the month. Though this was an increase of 3 percent over the August estimate, it was 4 percent less than the September 1948 figure. A decline in commercial and industrial activity in September, bringing the total well below the level of a year ago, is reported. Most other types of private non-residential building, together with construction by privately owned public utilities, were practically unchanged from August, at rates generally above last year.

Publicly financed construction amounted to $557 million in September, continuing at the August level but advancing 18 percent above the September 1948 total. Public housing expenditures, mostly state and local, were at nearly two and a half times the year-ago rate. School and hospital building showed small additional gains, maintaining substantial leads over last year. Most other types of public construction, including highway and conservation work, have leveled off at August peaks.

The total value of new construction put in place in the first nine months of 1949 amounted to $14 billion, 1 percent more than for the same period last year, according to the Construction Division of the Department. This slight rise is attributed to the fact that, while many types of private construction have dropped below the levels of a year ago, public construction has more than made up the difference.

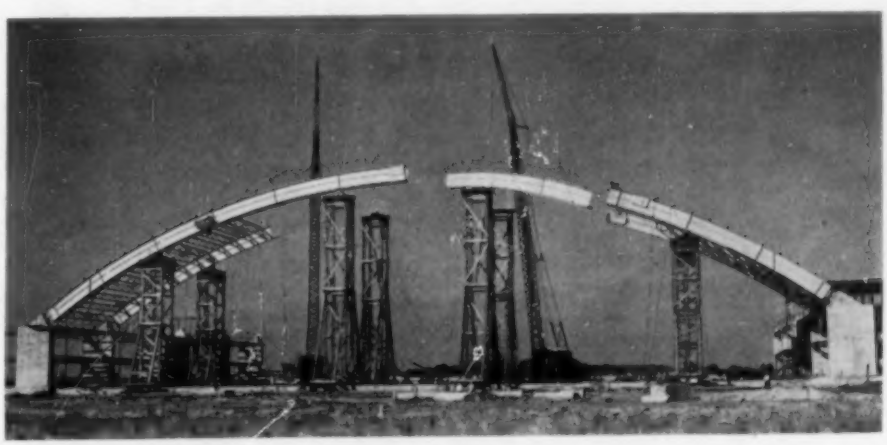
Port Authority Builds Huge Steel Hangars at New York International Airport

THREE LARGE TRIPLE-HINGED steel-arch hangars are being built by the Port of New York Authority at New York International Airport at a cost of $9,200,000. Scheduled for completion in May 1950, the new structures will provide approximately 200,000 sq ft of additional hangar accommodation and about 53,000 sq ft of airline shop, office, and cafeteria space. Each will comfortably accommodate four of the huge new Boeing Stratocruisers.

The hangars will be 217 ft in depth, with sliding doors at each end and with connecting structures between them. The roof arches, resting on concrete piers 25 ft high, are fabricated in four sections and are being erected with the aid of a set of timber towers and two cranes with 115-ft booms. Hinged with an 8-in. steel pin at the center and 10-in. pins at the side, the arches curve up to a height of 75 ft in the center. The supporting piers are constructed with huge concrete spread footings covering more than 1,000 sq ft of bearing area.

The new structures will be located in the north-central section of the airport close to the two existing hangars that were built by the City of New York several years ago. A large paved apron area will be constructed adjacent to the three hangars, and connecting taxiways leading to the terminal area and the runway system are planned.

The Stock Construction Co., is building the hangars for the Port Authority.



FIRST OF SERIES OF 18 GIANT STEEL ARCHES spanning clear distance of 300 ft, which will support three of world's largest triple-hinged steel-arch hangars, are swung into position at New York International Airport. These new hangars, under construction by Port of New York Authority, will be finished next May.

Steel Erection Speeded on N.Y.C. Skyscraper

STRUCTURAL STEELWORK IS TOPPED OUT on 25-story skyscraper in midtown Manhattan, which is being built by Turner Construction Co. for new home office of Mutual Life Insurance Co. Steel, furnished and erected by Bethlehem Steel Co., rose at rate of more than two stories a week, setting postwar record for speed. Completion date of 376-ft skyscraper has been advanced from middle of 1950 to April or May. Edwards & Hjorth, of New York, are structural engineers.

W. H. Nalder Leaves for U.N. Appointment Abroad

WILLIAM H. NALDER, M. ASCE, chief designing engineer for the Bureau of Reclamation, Denver, has accepted a United Nations request to serve with the Economic Survey Mission for the Middle East and left New York October 1 for Beirut, Lebanon, to join members of the Mission working there under the direction of Gordon Clapp, chairman of the Board of Directors of the Tennessee Valley Authority.

W. H. Nalder

The Mission is concerned primarily with the study of problems connected with the rehabilitation of 900,000 displaced Arabs, whose welfare is being considered by the United Nations. An employee of the Bureau of Reclamation for 40 years and a nationally known authority on irrigation and reclamation developments, Mr. Nalder will advise the Mission on reclamation work in the Middle East.

Highway Personnel Problems Studied at AASHO Meeting

PAPERS ON HIGHWAY engineering as a career, which were awarded prizes in the 1949 essay contest conducted by the American Association of State Highway Officials, were read at the recent 35th annual meeting of the AASHO in San Antonio, Tex. To attract competent engineers to state highway employment, Michael Lash, winner of the Student Division, advocated a definite program of promotion to recognize demonstrated ability; more adequate salaries; a good publicity program in the colleges; and well-organized training programs. Mr. Lash is a member of the ASCE Student Chapter at Tufts College and a Marine Corps veteran.

Emmett H. Karrer, Assoc. M. ASCE, professor of highway engineering at Ohio State University, top winner in the Faculty Division, stressed the many challenging problems that highway engineering offers in a country where millions of motorists must depend on safe good roads for their whole way of life. Summarizing the accomplishments of the past in the field, he concluded that, "Even more outstanding accomplishments will be made in the future by those who select highway engineering as a career."

ASCE Honorary Member Thomas H. MacDonald, Public Roads Commissioner, reported that nearly 50,000 miles of federal-aid highways have been opened to traffic since the war, and that another 19,000 miles are under construction or planned. Despite this progress, he noted that the program during the first eight months of the year is running about 20 percent below the corresponding period of 1948. The chief bottlenecks, according to Commissioner MacDonald, are a shortage of engineers and, in some states, insufficient revenues to meet rising construction and maintenance costs.

Dewitt C. Greer, state highway engineer of Texas, was elected president of the AASHO. J. A. Anderson, of Virginia, first vice-president; and G. H. Henderson, of Rhode Island, treasurer. All are ASCE members.

Decline in Building Costs Reported by AGC

CONSTRUCTION COSTS ARE at an estimated 10 percent below the recent peak, according to a release from the Associated General Contractors of America. Reporting the results of a nation-wide survey conducted among contractors by the AGC for study at the recent mid-year meeting of its governing and advisory boards at French Lick, Ind., the organization sees construction costs stabilized or declining slightly on a national scale.

Contractors generally report adequate supplies of materials, machinery, and manpower, with a marked increase in productivity and efficiency. Competition has become keen for the work coming on the market. "All these factors," they say, "mean that the public can now get full value for its investment in construction."

Room for more activity in all fields of construction—highway, building, heavy, and railroad—was reported, with about half the replies reporting more work coming on the market in the middle of the 1949 construction season. In most areas, industrial and commercial building was pictured as below last year's volume, and in many cases residential construction was said to be lagging. Indications are, however, that the slack is being taken up by a heavy volume of public and institutional building, which is expected to increase. Highway construction was reported hampered, in many instances, by lack of adequate funds or plans, except in certain states where considerable toll road construction is under way.

Awards Made in 1949 Welded Bridge Contest

FIRST PRIZE OF $3,000 in the 1949 contest for the best design of a two-lane 120-ft deck highway bridge of all-welded construction, conducted by the James F. Lincoln Arc Welding Foundation, goes to Thomas C. Kavanagh, Assoc. M. ASCE, professor of civil engineering at Pennsylvania State College, according to an announcement from the Foundation. Professor Kavanagh's prize-winning design incorporates a compact triangular-shaped steel frame to support the bridge roadway.

The second award of $1,500 went to Angel R. Lazaro, of Malabon, Republic of the Philippines, who has just received a master's degree in civil engineering from the State University of Iowa. Fred C. Miller, consulting engineer of Toledo, Ohio, is winner of the third award of $750. Recipients of honorable mention prizes include ASCE members Lawrence W. Cox, Omaha, Nebr.; James H. Jennison, Pasadena, Calif.; Hans H. Bleich, New York City; and Harold H. Gilbert, San Carlos, Calif.

VA Gives Contract for Hospital Construction

ANNOUNCEMENT OF THE award of a $6,985,905 contract for construction of a 500-bed general medicine and surgical hospital in Chicago to the J. L. Simmons Co., of that city, has been made by the Veterans Administration. To be built on a 13-acre site in the city's medical center district, the project will include construction of a 4,274,000-cu ft main hospital building, recreation hall, chapel, nurses' and attendants' quarters, and electrical substation. The buildings will have concrete foundations, brick-faced exterior walls with stone trim backed with hollow tile, reinforced concrete floors, and built-up roofs.

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LOGGING

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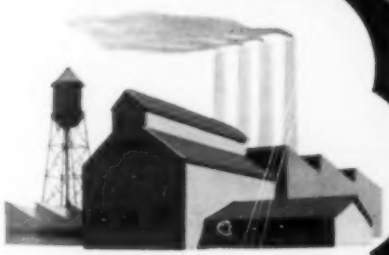
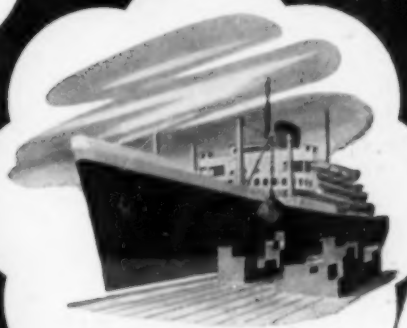
MINING

PETROLEUM



MANUFACTURING



MARINE

CONSTRUCTION

Pioneered

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UNITED STATES PATENT OFFICE

Richmond Screw Anchor Co., Inc.

Act of February 20, 1905

Serial No. 419,125

TYSCRU

1915

STATEMENT

To the Commissioner of Patents:

Richmond Screw Anchor Co., Inc., a corporation duly organized under the laws of the State of New York and located and doing business at 245 Bush Street, in the county of Kings, city and State of New York, has adopted and used the trade-mark shown in the accompanying drawing, for CONCRETE MOLDING APPARATUS AND PARTS THEREOF FOR CASTING CONCRETE IN SITU in Class 12, Construction materials, and presents herewith five specimens showing the trade-mark as actually used by applicant upon the goods, and requests that the same be registered in the United States Patent Office in accordance with the act of February 20, 1905, as amended.

The trade-mark has been continuously used in the business of said corporation, and in the business of its predecessor since December 15, 1914.

Applicant is the owner of trade-mark registration No. 104,378, dated June 1, 1915.

The trade-mark is applied to the goods by stenciling the same upon the boxes or packages in which the goods are packed or by attaching tags, tickets or labels bearing the mark to the goods or to the packages therefor.

The undersigned hereby appoints Harry Radzinsky (registry No. 10,805) of 535 Fifth Avenue, New York city, N. Y., as its attorney with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to receive the certificate and to transact all business in the Patent Office connected therewith.

RICHMOND SCREW ANCHOR CO., INC.

Act of March 19, 1920

Application May 31, 1934,

Serial No. 352,106

SNAP TYS

1934

STATEMENT

To the Commissioner of Patents:

Richmond Screw Anchor Co., Inc., a corporation duly organized under the laws of the State of New York, and located and doing business at 245 Bush Street, in the county of Kings, city and State of New York, has adopted and used the trade-mark shown in the accompanying drawing, for FORM TIES FOR CONCRETE FORMS, in Class No. 12, Construction materials, and presents herewith five specimens showing the trade-mark as actually used by applicant upon the goods, and requests that the same be registered in the United States Patent Office in accordance with the act of March 19, 1920.

The trade-mark has been continuously used and applied to said goods in applicant's business since the 15 day of May 1931.

The trade-mark is applied to the goods by stenciling the same upon the boxes or packages in which the goods are packed or by attaching tags, tickets or labels bearing the mark to the goods or to the packages therefor.

The trade-mark has been in bona fide use for not less than one year in interstate commerce by the applicant.

The undersigned hereby appoints Harry Radzinsky (registry No. 10805) of 233 Broadway, New York city, N. Y., as its attorney with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to receive the certificate and to transact all business in the Patent Office connected therewith.

RICHMOND SCREW ANCHOR CO., INC.

in 1915

in 1934

and in 1950

all signs point to

by RICHMOND

- **YOU *BUY* A PRODUCT . . . the finest in form-tying devices, engineered to do any form erection job . . . and we LOAN you all the working parts you'll need.**
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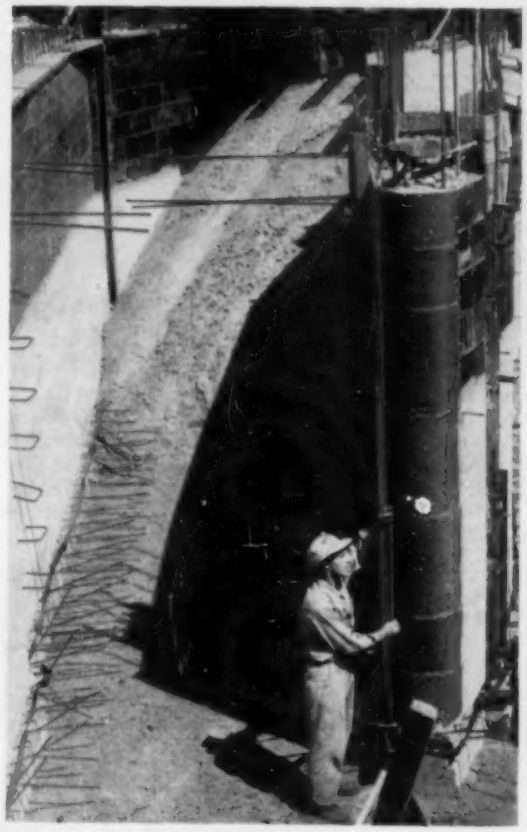
Vitrified CLAY PIPE AND CLAY LINER PLATES

PREVENT CORROSION AND DISINTEGRATION IN NEW 46 MILLION DOLLAR DISPOSAL PLANT

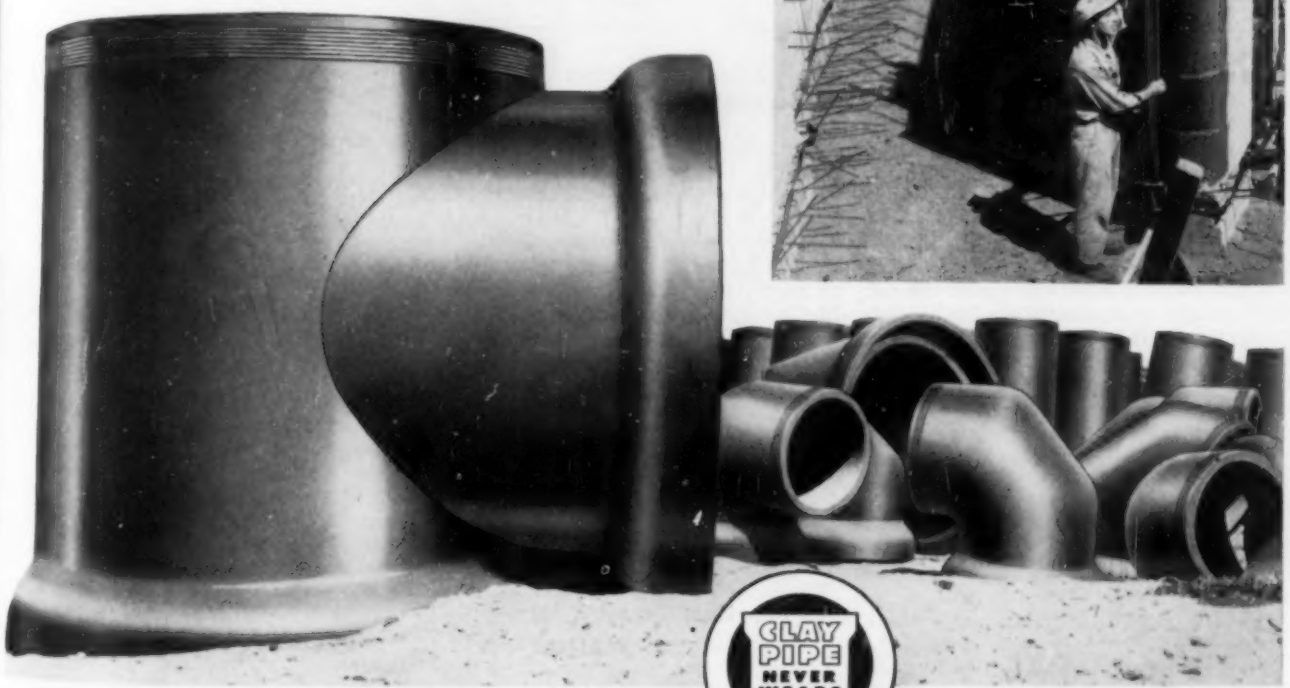
THE new sewerage treatment plant under construction at Hyperion, near Los Angeles, is designed to process waste disposal from an area populated by 3 million people. Its outfall sewer — 55 miles in length — is the longest of its type in the world.

Engineers in charge of the project rely on rust-proof, non-deteriorating Vitrified Clay Pipe and Clay Liner Plates to protect against acid attack. They know that Vitrified Clay Pipe is the *only* pipe that resists corrosion and crumbling . . . the *only* pipe that gives trouble-free service in *any* sewerage or drainage installation.



Corrosion-proof Vitrified Clay Liner Plates in huge sludge tanks protect masonry from acid-attack →

↓ *Vitrified Clay Fittings afford flexibility in laying and provide non-corrosive, non-deteriorating lines throughout the plant*



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Vitrified Clay Pipe withstands A.S.T.M. tests for acid-resistance without mar or mark. Clay Pipe comes through 48 hours of immersion in fiery acid solutions with flying colors. The reason? *Vitrification* at temperatures exceeding 2,000°F. makes Clay Pipe TOUGH . . . welds the pipe into a solid, integrated conduit that *cannot* rust, corrode or crumble.

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CLAY PIPE NEVER WEARS OUT!

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C-749-1

Tidal Hydraulics Experts Confer in Philadelphia

HYDRAULICS EXPERTS FROM ALL OVER COUNTRY meet in Philadelphia office of Army Corps of Engineers to delve into relatively unexplored field of tidal hydraulics. Shown here (left to right, clockwise around table) are Berkeley Blackman, South Atlantic Division, Atlanta, Ga.; Martin A. Mason, Assoc. M. ASCE, Beach Erosion Board, Washington, D.C.; Boris A. Bakhmeteff, Hon. M. ASCE, Columbia University, New York City; James R. Johnston, North Atlantic Division, New York City; Richard O. Eaton, M. ASCE, South Pacific Division, Oakland, Calif.; Jacob H. Douma, Assoc. M. ASCE, Office of the Chief of Engineers, Washington, D.C.; C. F. Wicker, Assoc. M. ASCE, Philadelphia Office of Army Engineers; Ralph F. Rhodes, M. ASCE, Savannah District, Savannah, Ga.; J. B. Tiffany, M. ASCE, Waterways Experiment Station, Vicksburg, Miss.; Lorenz G. Straub, M. ASCE, St. Anthony Falls Hydraulic Laboratory, Minneapolis; and Oscar Rosenzweig, Philadelphia District.

Increased Research Urged at Traffic Engineers Meeting

TRAFFIC ENGINEERING AND research are now recognized as essential to the planning and execution of sound highway work, ASCE Honorary Member Thomas H. MacDonald, Commissioner of Public Roads, told highway engineer and traffic experts from all over the country in attendance at the recent 20th annual meeting of the Institute of Traffic Engineers in Washington, D.C. He stressed the need for more thorough knowledge and understanding of facts, through painstaking research, and declared that "The legal authority to raise research from a detached high-brow status to a living tool for intelligent and efficient administration should be incorporated in every public appropriation to provide facilities to serve the public."

Commenting on various factual study projects, Mr. MacDonald drew special attention to the project under way in Albuquerque, N. Mex., where city, state, and federal funds and technical personnel have been pooled to make a comprehensive survey of the transportation needs of the metropolitan area.

New officers elected for the coming year are Wilbur S. Smith, Assoc. M. ASCE, associate director, Yale Bureau of Highway Traffic, president; Nathan Cherniack, M. ASCE, economist, Port of New York Authority, and Harry E. Neal, chief engineer, Division of Traffic and Safety, Ohio State Highway Department, vice-presidents; and Henry W. Osborne, traffic engineer for the City of Buffalo, N. Y., secretary-treasurer.

The attendance of 400 was the largest in the 20-year history of the Institute.

Mechanical Engineers Elect Officers for 1950

ELECTION OF JAMES D. Cunningham, president of Republic Flow Meters Co., of Chicago, as president of the American Society of Mechanical Engineers for 1950, has been announced by the ASME. Regional vice-presidents elected to serve two-year terms on the ASME Council are Frank M. Gunby, M. ASCE, associate and director of Charles T. Main, Inc., Boston; John C. Reed, head of the mechanical engineering department at Bucknell University, Lewisburg, Pa.; Albert C. Pasini, assistant superintendent, Detroit Edison Co., Detroit, Mich.; and Samuel H. Graf, director of the Engineering Experiment Station at Oregon State College, Corvallis, Ore.

Reclamation Bureau Lets Several Western Contracts

RECENT AWARD OF several contracts on large Western construction projects has been announced by the Bureau of Reclamation. These include a $1,266,056 contract to J. A. Terteling & Sons, Inc., of Boise, Idaho, for construction of earthwork, concrete canal lining, and structures for Courtland Canal, part of the Missouri River Basin Project, Nebraska and Kansas; a $4,787,874 award to the Wunderlich Contracting Co., of Omaha, Nebr., for construction of Olympus and Pole Hill Tunnels and access roads for the Estes Park-Foothills power aqueduct, Colorado-Big Thompson Project, Colorado; and a $4,273,872 contract to the Morrison-Knudsen Co., Inc., and M. H. Hasler Construction Co., Los Angeles, Calif., for building earthwork, concrete lining, and structures for the Delta-Mendota Canal Central Valley Project, California.

Exchange Fellowships Are Offered for Study Abroad

AVAILABILITY OF 648 exchange fellowships for Americans wishing to do teaching, research, or graduate study abroad is announced by the State Department. These fellowships are made possible under the terms of the Fulbright Act, which authorized the State Department to use foreign credit acquired abroad through the sale of surplus property for the purpose. Similar fellowships will be made available by the United States for nationals of the various countries represented in this international educational program. Countries participating, in addition to the United States, are Belgium, Burma, France, Greece, Iran, Italy, Luxembourg, the Netherlands, New Zealand, Norway, the Philippines, and the United Kingdom, including its colonial dependencies.

Inquiries concerning the competition for awards, which closes December 1, should be addressed either to the Fulbright program adviser on university campuses, or to one of the following: Institute of International Education, 2 West Forty-fifth Street, New York City; Conference Board of Associated Research Councils, 2101 Constitution Avenue, Washington 25, D.C., or the United States Office of Education, Federal Security Agency, Washington 25, D.C.

New Cuts in Cost of Home Construction Made Possible

NEW USES OF lath and plaster to lower the cost of homes and other on-the-site construction have been announced by the Armour Research Foundation of the Illinois Institute of Technology. Reporting the results of tests of different types of plaster mixes and wall and ceiling construction made for the Department of Commerce, the Foundation concludes that: (1) In the past, many joists have been stiffer and more costly than necessary because of a 120-year-old stress formula not applicable to modern materials or methods; (2) walls can be made stronger and more resistant to plaster cracks by merely changing the position of lath for better reinforcement where greater stresses occur; (3) plaster strength increases when the proportion of sand included decreases; and (4) proper plaster thickness and application aids resistance to cracking.

Adoption of the Foundation's findings would lead to "sturdier plaster construction, lower cost of upkeep, and enhanced appearance of the plaster surface by reducing cracks," according to William T. Savage, Jun. ASCE, supervisor of the materials section of the Armour Foundation, who was in charge of the project.

E.S. Library Originates New Photoprint Service

A COMPREHENSIVE PHOTOPRINT service, designed to save readers time and trouble, has been initiated by the Engineering Societies Library. Through this service, photoprint copies of any engineering or technical article available anywhere in the United States will be supplied, whether or not the article is in the Library. There will be a flat charge of $5 an article for papers not over 25 pages long, with an extra charge of $2.50 for each additional 25 pages or fraction thereof.

Organizations and individuals wishing to avail themselves of the comprehensive service will be obliged to agree, in writing, to accept the conditions of the plan as the basis for all their photoprint orders. Copies of the agreement form may be obtained from the Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

Under the limited library service offered in the past, only material in the library will be copied. Rates are 40 cents a print, with a minimum charge of $1 an order. Reductions of 50 cents in both comprehensive service charges and of 5 cents a print in the limited service charge are available to members of the Founder Societies.

USBR Requests Bids on Several Large Projects

AMONG WESTERN CONSTRUCTION projects on which the Bureau of Reclamation will request bids by December are 17 miles of 2,500-cfs-capacity concrete-lined Friant-Kern Canal, part of the Central Valley Project in California; 9.5 miles of 1,300-cfs-capacity concrete-lined Wellton-Mohawk Canal, and relocation of 4.5 miles of county road east of Yuma, Ariz., part of the Gila Project; and the 6.5-mile Tecolote Tunnel, and 1.8 miles of access road, part of the Santa Barbara, Calif., Project.

Bid requests for construction of Keyhole Dam, originally asked for November (page 57, October issue), have been deferred a month. Located on the Belle Fourche River, northeast of Moorcroft, Wyo., this project consists of an earthfill structure 109 ft high and 3,300 ft long at the crest.

Progress in Repair of War-Damaged Philippine Highways Reported

SUBSTANTIAL PROGRESS HAS been made in the reconstruction of war-damaged streets and highways in the Philippines, according to the U.S. Bureau of Public Roads. Approximately 100 miles of roadway and more than 20 bridges have been rebuilt or repaired at a cost of around $6,000,000, much of which was advanced by the United States. Completed projects include the Quezon and Santa Mesa boulevards and most of the other principal thoroughfares in Manila. The two boulevards, which carry the bulk of the city's traffic, were reconstructed as six-lane divided highways.

Widening and repair work is still under way on less important streets, which have deteriorated since the war because of lack of maintenance. A similar street-improvement program, calling for expenditure of $779,100, has been started in Cebu, second largest city in the Philippines. Also under construction are two major bridge projects in Manila—the Quezon and Jones bridges across the Pasig River.

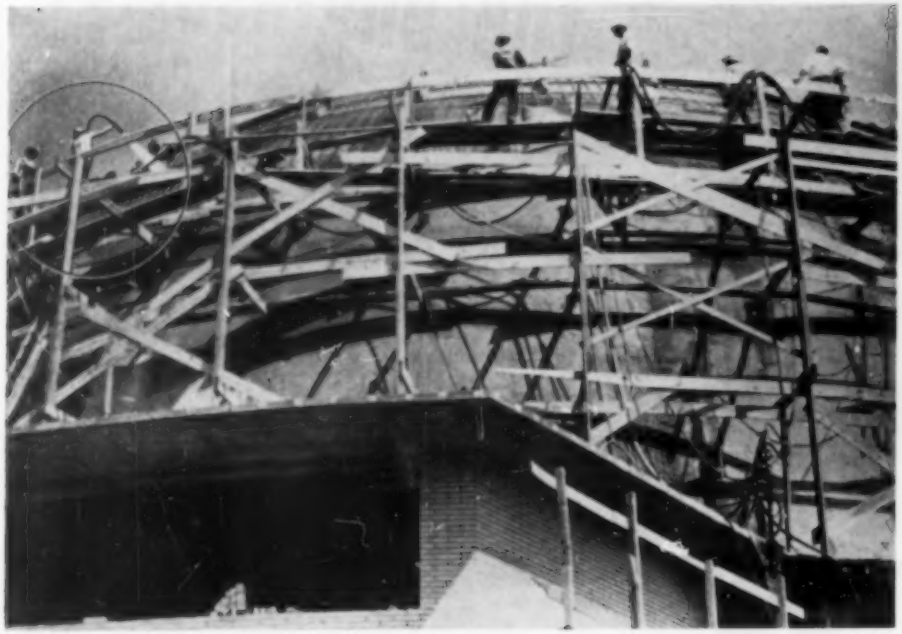
Both completed projects and those under construction are part of a program of 320 road and bridge projects authorized by the Rehabilitation Act of 1946. Out of 320 projects recommended, a total of 304 have been definitely planned. These provide for the reconstruction or repair of 355 miles of roads and streets and of 224 bridges at an estimated cost of $48,647,787. Of this amount, $33,736,000 will be contributed by the United States.

As a further aid to the Philippine highway program, the U.S. Bureau of Public Roads has purchased and stocked reinforcing steel and road-building equipment for use there; has set up a 3,000-lb hot-mix plant for use on bituminous paving jobs in and near Manila; and has developed a physical research laboratory to test road materials and train Philippine personnel in research methods. Considerable effort has also been directed toward an over-all training program for Philippine engineers, which includes sending American engineers to the Philippines to teach and bringing Philippine engineers here for special training.

Barring unforeseen delays, all projects will be under contract by the end of June 1950. About $10,000,000 worth of highway and bridge projects remains to be designed.

CONSTRUCTION OF SANTA MESA BOULEVARD (left) is accomplished by hand work of native laborers. Work on this main thoroughfare could not be deferred until modern concrete-paving machinery was obtained. Road between Manila and Batangas (right-hand photo) was rebuilt as two-lane concrete highway. Photos courtesy of U. S. Bureau of Public Roads.

Gunite Process Is Utilized in Dome Construction



CONCRETE DOME of new Park Temple of Cleveland Jewish Center, Cleveland Heights, is being built by Gunite process, which employs pneumatic hoses having nozzle pressure of 30 psi to blow mixture of sand, cement, and water over hemispheric wooden form 100 ft in diameter. The concrete dome, which will be sheathed in copper later, is one of few structures in country to be built by this process. Supported by six reinforced-concrete columns anchored in bedrock, it will have an area of 18,000 sq ft, thickness of 4 in., and weight of over 500 tons. Three crews, working nine hours a day, 15 working days, were required to complete the job.

Steel Industry Closes Record Decade of Expansion

STEEL COMPANIES IN the United States spent $3.2 billion on expansion of their facilities in the 1940's, and the production capacity of the industry was increased 16,000,000 tons, according to the American Iron and Steel Institute. Hailing the close of a record decade for the industry in a recent issue of *Steel Facts*, the Institute states that, "in many ways, the ten years of the 1940's stand out as the greatest in the history of the steel industry."

Despite such obstacles as shortages of manpower and materials, difficulties in getting equipment, strikes, and other problems, 800,000,000 tons of raw steel were produced in this period. This was "twice the amount produced in the 1930's and 70 percent above the output of the 1920's," the Institute points out. "In fact, the percentage gain of the 1940's over the 1930's was by far the greatest of any decade this century." Production of this huge tonnage required more than a billion tons of iron ore, 875,000,000 tons of coal, 440,000,000 tons of scrap, and vast quantities of other materials, the Institute states.

Monthly production of raw steel attained a record of more than 8,000,000 tons early in 1949. This record represented a steady rise from an output of between 4,000,000 and 5,000,000 tons in the early months of 1940.

The industry's amazing record in demand, production, and expansion has been facilitated by equally sweeping technological advances. Among these, the Institute lists the increased size of furnaces, the development of automatic process controls, and control of hardening.

Also cited is the rapid growth of electric furnace steel production, reflecting the increased use of alloy steel. Production of alloy steel attained a record of 14.8 percent of total steel output in 1943. Since the war it has run a little less than 10 percent of the total output. "Included in the alloy situation," the Institute states, "is the rapid expansion in the use of stainless and heat-resisting steel. Prior to 1940 the annual output of stainless steel, the flowering of modern metal science, ran less than 200,000 tons, but in that year it rose to nearly 250,000 tons and in 1948 reached 617,000 tons.

"With the rising demand for sheets in consumer goods came the development of the wide continuous sheet mill. From 1929 to 1939 the number of such mills rose from 7 to 27. Since the war, sheets have risen to one-quarter of production, not including sheets and strip for black plate and tin plate. The gradual change in emphasis from heavy to light steel through five decades reflects the growth in use of steel in automobiles and other consumer durable goods."

R. Robinson Rowe, M. ASCE

"I THINK," MUSED Professor Neare, "that Guest Professor Canby Dunn's problem in absolute differential reduction is going to be a lesson in 'analysis vs. synthesis.' Can be, can't it, Canby?"

"A lesson to those who would learn, Noah. But not to Joe."

"Now, now, Professor Dunn," retorted Joe Kerr, "you'll be surprised to learn that I solved your four-number problem. You asked for four numbers that would reduce to zeros after 20 absolute differentials, and that's four unknowns without even one equation. Instead of analysis or synthesis, I used Kerrtosis, the skewy method. I tried four random squares and reduced to zeros in six steps. Cubes did no better, so I tried telephone numbers and populations of states, but no matter how big or how random, the numbers petered out fast. On a hunch, then, I opened my table of primes and picked a random number from each of four random pages and here are the first and last two steps:

Answer	13	1171	3301	7219
Step 1	1158	2130	3918	7206
Step 2	972	1788	3288	6048
19	384	384	384	384
20	0	0	0	0."

"If I may protest as usual," said Cal Klater, "I'd like to read Joe the real question, 'How many accidents *must* there have been in 1948?' He forgot that when he was trying all the telephone numbers. His first line adds to 11,704 accidents, but the question implies the least number, which is 1,942. The same steps, dated, are:

1948	0	193	548	1201
1949	193	355	653	1201
1950	162	298	548	1008
1967	64	64	64	64
1968	0	0	0	0

"My method was synthetic, I suppose. I started with the set 0, 1, 2, 3 and 'integrated' it to 1, 1, 2, 4 and again to $\frac{1}{2}$, $1\frac{1}{2}$, $2\frac{1}{2}$, $4\frac{1}{2}$. I doubled this to clear fractions and continued the process until I had 230, 423, 778, 1431, which was a 20-step set. Then I subtracted 230 from each number to get the minimum set with the same first differential."

"Good clear synthesis, Cal," said Professor Dunn. "You'll be interested in a general solution in serial form:

$S_1 = 0, 0, 1, 1, 2, 4, 7, 13, 24, 44, 81, \ldots$
$S_2 = 0, 1, 2, 3, 6, 11, 20, 37, 68, 125, \ldots$
$S_3 = 1, 1, 1, 3, 5, 9, 17, 31, 57, 105, \ldots$

In each series, the first three items are generators and the subsequent items are sums of the preceding three. Either sums or differences of consecutive pairs of S_1 generate S_2; similarly S_2 generates S_3 and S_3 generates $2S_1$. The minimum normal solution for a reduction in any given number of steps is given by four consecutive items of some one of the three series. If I had time, Noah, I could talk for hours about these intriguing groups."

"And I'd listen, Canby. It was an interesting problem worthy of a sequel. My approach, at first, was analytic, to find a set that would reduce to a proportionate set. It was the geometric series a, ar, ar^2, ar^3 in which $r^3 = r^2 + r + 1$, so that $r = 1.83928675521416113$. Convergents of this fraction lead to a solution, but it takes synthesis to generate the minimal. Now for the sequel. The game can be played with 2^n numbers, that is with 2, 4, 8, 16 etc. For 2, it is trivial; for 4 it is solved; for 16 it is laborious. Let's find the least set of 8 different numbers which will reduce to zeros in 20 steps."

[*Cal Klaters were: John L. (Stoop) Nagle, Marvin A. Larson and Anne Othernut (J. Charles Rathbun). Guest Professor Canby Dunn is still D. B. Steinman.*]

R.P.I. Celebrates 125th Anniversary of Its Founding

INDUSTRY CAN ABSORB the present available number of competent engineers, Gen. Brehon B. Somervell, Hon. M. ASCE, president of the Koppers Co., told engineers and industrialists attending the recent three-day program marking the 125th anniversary of Rennselaer Polytechnic Institute. Speaking in a panel discussion on "What Industry Expects of the Engineer," General Somervell expressed the opinion that nontechnical studies are important enough to warrant extending engineering curricula to five or even seven years. Rear Admiral Carl H. Cotter, M. ASCE, president of Merritt, Chapman & Scott, also emphasized the need for extending engineering education beyond the present four-year curricula.

Commenting on the topic, "The Engineer in Human Relations," three industrial executives and the editor of a technical magazine agreed that if industry is to realize its great potential it must in the future, consider skills in human relationships fully as essential as technical abilities in the production of goods. Panel discussers included Lewis Sillcox, M. ASCE, vice-president of the New York Air Brake Co.

In his first major address in the United States, which highlighted the dinner meeting program, Louis St. Laurent, Prime Minister of Canada, emphasized Canada's determination to cooperate to the fullest extent with the United States for mutual defense and world peace. Pointing out that the application of science and engineering to soil conservation, production of better crops, and more economical use of field and forest might be even more important than the further development of industry to the future of the race, Mr. Laurent concluded his remarks with the statement that in these and other fields of betterment, "There is only one nation with the wealth and the energy and the knowledge and the skill to give real leadership, and that nation is the United States."

There were several thousands in attendance at the three-day meeting. The general committee in charge of arrangements was headed by Livingston W. Houston, president of R. P. I., as honorary chairman, and Edward P. Hamilton, Assoc. M. ASCE, president of John Wiley and Sons, Inc., chairman.

NEW IN Education

DEVELOPMENTS IN WASTE disposal and utilization will be covered at the Fifth Industrial Waste Conference, to be held at Purdue University, November 29 and 30. Subjects treated will include changes in laws and regulations, stream qualities, stream surveys, industrial wastes, laboratory procedures, and conservation of resources. A registration fee of $4 will be charged. Room reservations should be made well in advance of the conference at the Union Club on the campus, or at the Fowler, Cedar Crest, or Lahr hotels.

TWO $1,000 FELLOWSHIPS for a year of graduate work in engineering at the Carnegie Institute of Technology have been awarded to natives of Mexico and Peru by the Albert J. Matthes Foundation. The fellowships, which are given annually to Latin Americans to promote inter-continental friendship and unity, go to Rene Saul, an electrical engineer of Mexico, and Edilberto Vega, a Peruvian civil engineer.

BOTH THEORETICAL AND practical aspects of the economics of sewage treatment will be considered at the second annual Public Health Engineering Conference, to be held at the University of Florida in Gainesville on November 18 and 19. At the Friday evening banquet M. Allen Pond, assistant chief sanitary engineer for the U.S. Public Health Service, Washington, D.C., will discuss the timely topics of federal aid for the development of sanitary engineering courses and the present status of the Federal Pollution Control Bill. The university's sewage treatment plant and sanitary research laboratory will be open for inspection on Saturday afternoon.

THE GRANTING OF a $10,000 civil engineering scholarship fund to the Georgia Institute of Technology by Jesse H. Jones, former Secretary of Commerce, has been announced by Dr. Blake Van Leer, president of the Institute. The fund is being established in honor of Gen. Lucius D. Clay, Hon. M. ASCE, who is referred to as a "professional engineer, and a great American soldier, statesman, and patriot." The scholarships, consisting of not less than $200 or more than $500 in any regular academic year, will go to young men "of outstanding ability who indicate a positive desire and intent to follow a life career in civil engineering". They will be chosen by the Georgia Tech Scholarship Committee from nominees submitted by General Clay. The fund will have a life of ten years.

THE U.S. ARMY engineering soils laboratory, located at Ithaca, N.Y., has been turned over to Cornell University for use by the engineering department and other university groups. Built in 1936, when the Army was making extensive flood control investigations in the southern tier of New York State, the buildings are valued at $25,000. The transfer was made by order of Brig. Gen. George J. Nold, M. ASCE, engineer in charge of the North Atlantic Division. Since the inception of the laboratory, Cornell students have been observing the army's research program.

TO KEEP PRACTICING engineers abreast of new developments in the field of soil mechanics and foundations, the School of Engineering and the Extension Services of Pennsylvania State College are offering a short course in the subject on the college campus from January 30 to February 10. Designed for those with previous knowledge of mechanics and strength of materials, the course includes 40 hours of lecture work and 40 hours of laboratory. The charge for the course is $35 plus living expenses. Full information may be obtained from Miss Mary I. Fleming, Central Extension, Pennsylvania State College, State College, Pa.

TWO GRADUATE FELLOWSHIPS for the study of additives to concrete have been established at the University of Kentucky by the Solvay Process Division of the Allied Chemical & Dye Corp. The fellowships will involve a grant of approximately $4,000 for one year. Research will be conducted at the university's Engineering Experiment Station.

Positions Announced

City of Berkeley, Calif. An examination for Director of Public Works, at a salary of $650 to $750 a month, is announced by the City of Berkeley, Calif. Applications are particularly invited from younger engineers of exceptional administrative ability and at least six years top-quality experience. The Department of Public Works is being reorganized under the council-manager government. The position will present an unusual opportunity for professional growth in a university-residential city. There are no residence requirements, but C.E. registration in California is necessary. Apply to the Personnel Department, City Hall, Berkeley, Calif.

NEWS OF Engineers

Lynn S. Beedle, research engineer for the department of civil engineering at Lehigh University, has been granted a leave of absence to accept an invitation from Cambridge University, England, to coordinate liaison on studies being made at the two universities on the strength of welded steel frames and their components.

Verne Alexander, formerly regional engineer for the Kansas City Regional office of the U.S. Weather Bureau, has been designated area engineer for the North-Central Area, comprising the Missouri and Mississippi River basins above Cairo, Ill. His headquarters will continue to be at Kansas City.

William F. Uhl, president of Chas. T. Main, Inc., consulting engineers of Boston, Mass., recently received an honorary degree of doctor of engineering from Tufts College. Dr. Uhl was cited for his services to the country in the field of hydraulic engineering. Dr. Uhl is an authority in the design and construction of hydroelectric plants.

John C. Gebhard, who supervised the construction of the Naval Training Center at Sampson, N.Y., and other important building projects for the Navy during World War II, has joined the Cornell University faculty as an assistant professor of civil engineering. A Cornell graduate of the class of 1919, Captain Gebhard has retired from the Civil Engineer Corps of the Navy after a career of 28 years.

Chester L. Allen, who recently retired as head of the department of civil engineering at Michigan State College, has joined the faculty of Clarkson College as an associate professor. A member of the Michigan State College staff since 1919, Professor Allen served as head of the civil engineering department from 1924 until his retirement.

Two ASCE members have been reappointed as state commissioners to direct military government in the United States Zone in Germany. They are **Murray D. Van Wagoner,** Bavaria, and **Maj. Gen. Charles P. Gross,** Wuerttenberg-Baden.

Glen N. Cox has been appointed chairman of the department of engineering mechanics in the New York University College of Engineering. On the faculty of Louisiana State University since 1929, Dr. Cox served, successively, as associate professor of civil engineering and engineering mechanics, professor of mechanics and hydraulics, acting head of the department of engineering mechanics, chairman of the department of hydraulics, and, finally, director of the school of hydraulic engineering.

Glen N. Cox

Erastus R. St. John recently became affiliated with Carburetor Corp. and Engine Air Service, Inc., of Mineola, N.Y., in the capacity of director and vice-president in charge of engineering. These consolidated companies specialize in the scientific overhaul and precise test of aircraft power plants and related activities.

Arvon L. Davies, formerly with the Raymond Concrete Pile Co., has been appointed assistant to the president of Merritt-Chapman & Scott Corp., of New York City.

Louis F. Hewett, who is a director of Merritt-Chapman & Scott Corp., has accepted the appointment of managing engineer of the newly created sales and public relations department of the firm. In this status, Mr. Hewett will have charge of further development of housing and other building in the New York metropolitan area and elsewhere. Mr. Hewett has been connected with Universal International Pictures, and Hewett Builders.

Arthur J. McNair, associate professor of civil engineering at the University of Colorado, is now head of the Cornell University Department of Surveying and Mapping.

Leo F. Crowley, lieutenant commander, Navy Civil Engineer Corps, is the new national president of the Seabee Veterans of America, having been elected during the second annual convention of the organization held recently in Atlantic City, N.J. Commander Crowley has been employed for the past 30 years in the City Engineer's office of the Department of Public Works, Detroit, Mich. He is a veteran of both World Wars, and during the recent war served with the 81st Construction Battalion in the European Theater.

Leo F. Crowley

Frank M. Clinton, for the past 12 years with the Bureau of Reclamation, has been promoted to the position of assistant regional director of Region I, the Pacific Northwest, with headquarters at Boise, Idaho.

Lawrence C. Crawford has been transferred to the post of district engineer of the U.S. Geological Survey's Columbus, Ohio, office. For the past nine years Mr. Crawford has been district engineer at Iowa City.

Vernal R. Bennion has become district engineer for the U.S. Geological Survey at Iowa City, Iowa. Since 1931, he has served in Utah, Missouri, New Mexico, West Virginia, and Maryland.

Edward W. Digges, recently in the North Atlantic Division of the Corps of Engineers, at New York, is now chief of the Utilities Section of the Alaska District office, with headquarters at Ft. Richardson, Anchorage, Alaska. Prior to his employment by the Engineer Corps, Mr. Digges was engaged by the Department of State on special work for the American Mission for Aid to Greece.

John C. Oliver, previously assistant city engineer at Vancouver, B.C., has been named chief engineer of that city.

George M. Shepard, since 1932 chief engineer of the St. Paul, Minn., Department of Public Works, was honored recently, for his long span of service, by the City Council, which named a new highway "Shepard Road" in his honor. The new road is being constructed along the Mississippi River beyond the "Loop." Long active in the Northwest Section of the ASCE, Mr. Shepard served a term as president. A past-president of the American Road Builders' Association's Municipal Division, Mr. Shepard is now a director of that division.

George M. Shepard

Harold D. Hauf, chairman of the department of architectural engineering at Yale University, succeeds **Kenneth K. Stowell** as editor of *Architectural Record,* which is published by the F. W. Dodge Corp. Mr. Hauf has been research consultant on the investigation of new materials and methods aimed at cost reduction in building construction.

E. E. Foster has been assigned by the Bureau of Reclamation to serve for a two-month period as a consultant for the Navy on the hydrologic and hydraulic features of a dam for water supply on Guam Island.

Grant M. Hinkamp is now affiliated with Lawrence Peterson & Associates, consultants of Milwaukee, Wis. Mr. Hinkamp was with the Allis-Chalmers Manufacturing Co. previously. During the last war, he was in the employ of the Stone and Webster Engineering Corp., as superintendent of construction of three ordnance plants.

Joseph B. Diamond, attorney at law and licensed professional engineer, has resigned as deputy commissioner of public works of the City of New York, to resume the practice of law in association with Bleakley, Platt, Gilchrist & Walker, at 120 Broadway, New York, N.Y.

Thomas D. Rose, until recently consulting engineer of Chapel Hill, N.C., has become city manager of that municipality.

Benjamin A. Wasil has been appointed instructor in civil engineering at Illinois Institute of Technology. Mr. Wasil holds a master's degree in civil engineering from New York University.

Floyd F. LeFever, on the staff of the U.S. Geological Survey for approximately 21 years, has been named district engineer at College Park, Md.

T. T. McCrosky has resigned his position with the Greater Boston Development Committee to become a partner in the firm of McHugh & McCrosky, community and regional development consultants of New York City.

W. P. Hughes, city engineer of Lewiston, Idaho, was named president of the International Northwest Aviation Council at a recent session held at the Davenport. Long associated with development of the aviation industry in the Northwest, Mr. Hughes was first president of the Idaho Aviation Association and has been in charge of the $1,500,000 Lewiston Airport.

(*Continued on page 86*)

THE problem of the old woman who lived in a shoe has been dumped in the laps of American city planners. What to do about the continuing expansion of industry ... the rapid growth of urban populations?

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(*Continued from page 84*)

Richard W. Cook, previously acting manager of the Atomic Energy Commission Office, Oak Ridge Operations, has been named manager. In his new capacity, Mr. Cook will administer contracts for the AEC at Oak Ridge, covering operation of the large uranium-235 production plants, the Oak Ridge National Laboratory, the community of Oak Ridge, and other related activities carried on within the area. For his work in the Manhattan District, Mr. Cook received the Legion of Merit.

John E. Kinney has accepted an appointment as sanitary engineer on the staff of the Ohio River Valley Water Sanitation Commission. Since 1946, Mr. Kinney has been engaged by the consulting firm of Morris Knowles, Inc., of Pittsburgh, Pa., on the design and installation of industrial waste-treatment plants. He also has had an appointment with the New York State Department of Health.

Henry G. Suehrstedt, of Sandusky, Ohio, has been named right-of-way engineer in the Ohio State Highway Department.

Alexander A. Fischback, Jr., was recently appointed district engineer, Water Resources Division of the U.S. Geological Survey, at Charleston, W. Va., succeeding **J. I. Perrey,** who has accepted a position with the State of Indiana.

J. L. Newman, lieutenant colonel in the Corps of Engineers, has been appointed chief of the Construction Branch in the Sacramento, Calif., office of the Corps. Recently, Colonel Newman served as acting project engineer of the Pine Flat Dam on the Kings River east of Fresno.

Deceased

Albert James Bain (M. '44) chief price adjustment specialist, South Atlantic Division, Army Corps of Engineers, Atlanta, Ga., died on September 17, at the age of 68. Colonel Bain spent his early career in construction work, and at various times later maintained engineering and architectural offices in San Francisco and Chicago. A veteran of both wars, he served as post engineer for the AUS at Fort Benning, Ga., in World War II, with the rank of colonel. He had been in the South Atlantic Division of the U.S. Engineer Office since 1943.

Geert Blaauw (Assoc. M. '09) of San Diego, Calif., died on August 30, at the age of 78. A native of Holland, Mr. Blaauw was educated there and at Cooper Union in New York. He specialized in the planning and design of hydroelectric plants, and had served as designer and squad leader on projects built by the Aluminum Company of America, the Alabama Power Co., the Electric Bond & Share Co., and the Trojan Engineering Corp. He had also been with the late Hugh L. Cooper, New York consultant, and more recently was in the engineering employ of the New York City Board of Water Supply.

Edwin Cameron Eller (M. '39) engineer of East Orange, N.J., died in South Orange on August 12, at the age of 50. Mr. Eller had been chief engineer of the Passaic Valley Water Commission and consulting engineer for the Rahway, N.J., Board of Water Commissioners. More recently he was in the engineering employ of the Radio Corporation of America. In World War II he served overseas as a colonel on General Patton's staff, in charge of the planning of field construction and the training of troops in that work.

Joseph Benedict Estabrook (M. '36) consulting engineer of Minneapolis, Minn., died on September 9, at the age of 60. A graduate of Harvard University, Mr. Estabrook had been in the consulting engineering field in Minneapolis since 1920. He was one of the founders of the firm of Burlingame, Hitchcock & Estabrook (now Hitchcock & Estabrook) with which he was connected for a number of years as vice-president. Mr. Estabrook served as an officer in the Corps of Engineers in World War I, and in World War II was sanitary engineer for E. I. du Pont de Nemours & Co., at the Hanford Engineer Works, Hanford, Wash.

Charles Rice Gow (M. '14) president of Warren Brothers Co., of Cambridge, Mass., died in Brookline, Mass., recently. He was 76. A graduate of Tufts College, Mr. Gow had been in the Medford, Mass., City Engineer's Office and Water Department and with the Boston Transit Commission. He was a former postmaster of Boston, and in World War I was in charge of the construction of the Boston Army Base.

Theodore Ferdinand Lange (Assoc. M. '08) of Springfield, Mass., died suddenly on September 8, at the age of 70. A graduate of Massachusetts Institute of Technology, Mr. Lange had early experience with the New York Central—from 1909 to 1916 as assistant engineer in charge of the construction of Grand Central Terminal Improvements. Later he was with the Charleston Industrial Corp., the U.S. Shipping Board Emergency Fleet Corp. For a number of years prior to his retirement he was president of the Biscayne Building Corp., in Miami, Fla.

Laurance Bradford Manley (M. '09) retired engineer of Philadelphia, Pa., died on February 11, according to word just received at Society Headquarters. Mr. Manley was 78 years old and a graduate of Massachusetts Institute of Technology, class of 1892. A specialist in subway construction, he had been with the Boston Transit Commission and, for many years, was in the Philadelphia Department of City Transit. He had also been office engineer for the Delaware River Joint Commission, on the construction of the Philadelphia–Camden high speed line. As construction engineer for Monks & Johnson during World War I, Mr. Manley built three shipways for the Bethlehem Shipbuilding Corp., at Sparrows Point, Md. He had written for numerous technical publications, and was a member of the Boston Society of Civil Engineers, the American Society for Testing Materials, and the American Society of Municipal Engineers.

Thomas Charles O'Reilly (Assoc. M. '47) of Long Beach, Calif., was killed in an automobile accident there on March 11, while on duty with the Long Beach Water Department in his capacity as assistant civil engineer in charge of heavy construction. He was 48. Mr. O'Reilly had been in the Long Beach Water Department for the past 25 years, except for a three-year period in a U.S. Naval Construction Battalion in the South Pacific from 1943 to 1946.

Frederick Hilton Paget (Assoc. M. '32) senior hydraulic engineer in the California State Division of Water Resources and chief of the State Snow Survey, Sacramento, Calif., was fatally stricken at the wheel of his car near Trinity Center, Calif., on September 16, while making an inspection tour of the Trinity National Forest. A native of Nova Scotia, Mr. Paget attended Magill University in Montreal and graduated from the University of California as a hydraulic engineer. He first entered state service as a junior hydraulic engineer for the Division of Water Resources in 1930. In 1933 he left the state for service with the U.S. Forest Service, but returned to the Division in 1936. During World War I, Mr. Paget served as a lieutenant in the Canadian army. Long active in the work of the Sacramento Section, he was president at the time of his death. He was also an active member of the American Geophysical Union and the Western Snow Conference.

Frederick H. Paget

Edward Newton Todd (M. '24) of Richmond, Ky., died on September 1, at the age of 76. Mr. Todd was assistant superintendent of construction for the War Department at Galveston, Tex., from 1910 to 1912, and civil engineer and superintendent of construction for the Department at various Army posts in the United States and the Philippines from 1912 to 1920. Entering highway work, he then became resident engineer and principal assistant engineer for the Oklahoma State Highway Department, and later was resident engineer and chief highway engineer for the Kentucky Highway Department. In the latter capacity, Mr. Todd reorganized the department and inaugurated a complete traffic and marking system.

Clayton Norman Ward (M. '26) consulting engineer of Madison, Wis., died recently at the age of 59. A graduate of the University of Michigan, Mr. Ward taught there from 1914 to 1916 and at the University of Wisconsin from 1916 to 1925. In the latter year he joined the engineering staff of Mead & Seastone in Madison for work on field surveys, reports, and designs. Later he was chief engineer for the successor firm of Mead, Ward & Hunt, and of recent years had a consulting practice in Madison under the firm name of Ward & Strand.

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CIVIL ENGINEER; Assoc. M. ASCE; 39; married; 15 years' experience in heavy construction, dams, tunnels, cofferdams and related foundation work; power plant, industrial buildings, layout, and supervision of construction. Also experience in administration work. Speaks Spanish. Available immediately; location optional. C-533.

CIVIL ENGINEER; M. ASCE; B.S., Purdue University; registered engineer, Wisconsin; capable of assuming major responsibilities on sanitary problems and on construction work of all kinds. Have supervised work of many engineers, and been in charge of large projects. Available on short notice. C-534-C.

CIVIL ENGINEER; Jun. ASCE; 28; single; B.S. in C.E.; 2 years' experience as field and office engineer, County Highway Department; draftsman, computer, surveyor, foreign including some railroad design and railroad surveying; structural draftsman on power plants including some reinforced steel checking and railroad track layout. Desires field engineering position with contractor, salary $4,800 a year. Location, optional. C-535-31-C.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

CIVIL ENGINEER; Jun. ASCE; 22; single; veteran; B.S., C.C.N.Y., February 1949 (cum laude); Tau Beta Pi. Desires position in field or office doing structures or hydraulics. C-536.

CONSTRUCTION ENGINEER; M. ASCE; 44; 22 years' experience in design and construction of institutional and commercial buildings, housing developments, utilities, airports and highways—8 years in South America. Fluent Spanish. Willing to go anywhere; can report single status. Available immediately. C-537.

CIVIL ENGINEER; Jun. ASCE; 31; doctor's degree; some experience in structural work and precise surveying; presently employed as writer and editor of technical reports with headquarters U.S. Forces in Austria; desires position in Europe. Speaks German fluently, some Italian. Available on short notice. C-538.

SALES ENGINEER OR REPRESENTATIVE; Jun. ASCE; 26; married; B.S. in C.E. Engineering and sales experience. Opened and developed Chicago territory for manufacturing company. In charge sales, promotion, etc., doubled production; know concrete and steel products in construction and allied fields; ambitious, hard hitting salesman; desires greater responsibility, higher earning potential, and future. C-539.

CIVIL ENGINEER; Jun. ASCE; 31; married; graduate; registered. Two years' experience in responsible charge of new construction and equipment installation for chemical and paint industry. Prior experience in railroad and highway construction, surveys and plans, and estimates. Desires office or field position in engineering department of industrial or public utility company. C-540.

CIVIL ENGINEER; Jun. ASCE; 30; single; graduate. Experience in general construction and administration; desires position with construction or structural engineering firm; prefers Midwest, West, or Overseas. Available January 1, 1950. C-541.

Positions Available

CIVIL ENGINEER, graduate, with broad experience, a substantial portion of which has been in hydraulics. Excellent opportunity with a large public utility. Apply by letter stating education, experience, and salary requirements. Location, eastern Pennsylvania. Y-2413.

SALES ENGINEER, 30–40, civil graduate, with some selling experience and experience in concrete technology, concrete design, and construction. Some traveling. Salary, $4,000–$4,800 a year. Location, Middle Atlantic States. Headquarters, New York, N.Y. Y-2556.

ASSISTANT DIRECTOR OF ENGINEERING, 35–45; mechanical or civil degree, with knowledge of food processes, plant maintenance. Must have 12 years' experience. Will coordinate specialized design work on machines and equipment; designate types and quality of materials to be used in engineering projects; originate and suggest methods and method improvement. Keep records of work being performed and jobs to be done—drawing and specification files. Will contact contractors, suppliers, and engineering firms. Must be able to supervise engineers. Salary, $7,000–$8,500 a year. Location, Minnesota. Y-2602.

MINING OR CIVIL ENGINEER, experienced in driving tunnels in hard rock in connection with mining anthracite coal. Four-year contract. Salary open. Location, Turkey. Y-2671.

CIVIL ENGINEER, 35–45, to supervise project engineers on building work, waste disposal, and general civil engineering design for chemical company located in the East. Write stating experience, education, and salary requirements. Y-2690.

MUNICIPAL ENGINEER, preferably civil graduate, with license, and at least 5 years' actual experience in municipal public works and engineering to act as consultant to city officials regarding engineering standards and specifications, analysis of costs, and development of standards performance, determination of equipment needs, and application of approved public works practices generally, including surveys and preparation of reports, manuals, etc., of general use and practical benefit to local municipal officials. Salary, $4,200–$5,000 a year. Location, Southern state university. Y-2757.

ASSISTANT FIELD ENGINEER with public works construction experience, to give line and grade, check quantities, etc., on water line job. Salary, $3,380–$3,900 a year. Location, Washington, D.C. Y-2848.

CIVIL ENGINEER with at least 8 years' hydraulic experience, including stream surveys, run-off, underground waters, etc. to supervise engineering survey, water supply design and hydrological

work. Salary, $7,000–$8,000 a year. Headquarters, New York, N.Y. Y-2864.

SALES ENGINEER, 28–32, civil graduate, with highway and airport construction experience, to promote and supervise the use of asphaltic products. Salary, $3,600 a year. Location, New Jersey. Y-2882.

DESIGNER, graduate civil engineer, well experienced in reinforced concrete design, with thorough knowledge of soil mechanics, and well versed in concrete arch analysis and moment distribution as applied to underground continuous concrete structures. Salary, $5,000–$6,000 a year. Location, Chicago or vicinity. R-5845.

JUNIOR ENGINEERS, graduate C.E. under 30; several years' experience in concrete mixes. Will be assigned to material yard supervising concrete mixes, check with building specifications, serve as liaison between material job and construction job. Salary, $3,600 a year. Location, Chicago, Ill. R-5969.

ARCHITECTURAL ENGINEER-DRAFTSMAN, graduate, capable of handling problems in plumbing, heating, electrical, and structural engineering; require administrative ability, to direct part of drafting room work; desire considerable practical experience for architectural firm. Salary, open. Location, Wisconsin. R-5973.

Meetings and Conferences

American Institute of Chemical Engineers. Headquarters for the annual national meeting of the American Institute of Chemical Engineers will be the William Penn Hotel, Pittsburgh, Pa., December 4–7.

American Society for Engineering Education. A varied program is planned for the fourth annual meeting of the Upper New York Section of the American Society for Engineering Education—sponsored by the Division of Engineering of the University of Rochester and the Eastman Kodak Co.—November 18 and 19.

American Society of Mechanical Engineers. The annual meeting of the American Society of Mechanical Engineers will take place at the Hotel Statler, New York City, November 27 through December 2.

American Society of Refrigerating Engineers. Specialized problems of the refrigeration industry are to be discussed during the 45th annual conference of the American Society of Refrigerating Engineers, at the Edgewater Beach Hotel, Chicago, Ill., December 4–7.

American Petroleum Institute. "Ninety Years of Progress" will be the theme of the 29th annual convention of the American Petroleum Institute at the Stevens Hotel and Palmer House, Chicago, November 7–10.

American Road Builders' Association. The fall conference of the American Road Builders' Association is scheduled for Washington, D.C., on November 17.

National Air Pollution Symposium. Four technical sessions are planned for the National Air Pollution Symposium—sponsored by Stanford Research Institute in cooperation with California Institute of Technology, University of California, and University of Southern California—at the Huntington Hotel, Pasadena, Calif., on November 10 and 11.

Small Homes Council to Study Building Techniques

TO GIVE HOMEOWNERS an opportunity to have both variety in house design and economy in construction, the Small Homes Council of the University of Illinois is undertaking a one-year study of planning and building techniques. The project will involve the study and development of a series of standard room units that can be arranged easily and economically in a number of complete house plans. Cost-saving construction techniques, recently developed and tested under the industry-engineered house program, will be utilized.

The investigation is being carried on under a research grant given to the university by the newly organized Lumber Dealers Research Council.

Low Accident Rate in Steel Industry Reported

STEELWORKERS HAD FEWER accidents on the job in 1948 than ever before, according to an American Iron and Steel Institute study of data published by the National Safety Council. With an accident frequency rate 4 percent lower than in 1947, steel was the fourth safest among 40 major industries, the Institute states. The accident frequency rate was 5.86 per million man-hours worked, a figure 49 percent lower than the average for all industries. The Institute points out that this record is particularly notable because it was set during the year of greatest peacetime steel output, by the second largest labor force the industry has employed.

Productive Fields for Research in Sanitary Engineering

(*Continued from page 54*)

Atomic Energy Production," by Arthur E. Gorman, M. ASCE, Sanitary Engineer for the Atomic Energy Commission. Papers for presentation at this session which were received at ASCE Headquarters prior to the meeting are reviewed below.

Rolf Eliassen

Since sanitary engineering is an applied science, its principles rest on the fundamental sciences of physics, chemistry, biology and mathematics, to which must be added other applied sciences such as medicine, mechanics, economics, and engineering, Professor Eliassen stated in his paper. "The function of the sanitary engineer," he explained, "is to correlate research findings, and incorporate them into devices to control certain human environments for the ultimate benefit of public health."

Some important contributions to research in this field have been and are being made by federal agencies. The most promising laboratory, the author stated, is the Environmental Health Center of the Public Health Service at Cincinnati, recently authorized by Congress. Its scientific personnel will be administered by a sanitary engineer, he said.

The Public Health Service has also stimulated sanitary engineering research by grants made through the Environmental Health Study Section. This Section, initiated in 1946, has approved 103 applications, mostly to engineering colleges and universities, for funds totaling $849,406. Under the terms of the Federal Water Pollution Control Act, the Public Health Service has also made allotments totaling another $850,000, to all the states for the study of industrial waste pollution.

"What is the future of research in sanitary engineering?" Professor Eliassen asked, and then enumerated several acute problems which need solution. Among these problems is the effect of radio-isotopes on water supplies, sewerage systems, streams and the atmosphere, and the safe disposal of radio-active wastes; methods to more rapidly digest sludge at sewage treatment plants, thereby materially reducing treatment plant costs; and methods of improving the utilization of air in the activated sludge process far above the possible 1 percent of air now utilized in supplying oxygen to the sludge.

40-Million-Dollar Suspension Bridge to Link Delaware, N.J.

(*Continued from page 43*)

Terminal at Pidgeon Point on the Delaware side, about one mile north of the bridge site. The cement for the land piers was unloaded and elevated directly into hoppers at the mixing plants. The aggregates for the river work and the Delaware land piers are delivered on barges directly to the mixing plants. For the New Jersey land piers, the aggregates were shipped to the mixer site by rail.

All other materials for the river work are shipped through the Wilmington Marine Terminal, where they are loaded on barges and transported to the pier sites. For the Delaware land piers, such materials were delivered to the site by truck, and for the New Jersey land piers, by rail.

Contractors are listed in Table I.

Engineers for the Delaware State Highway Department are Howard, Needles, Tammen and Bergendoff, of Kansas City and New York, with O. H. Ammann, M. ASCE, and Moran, Proctor, Freeman & Mueser, as consultants. The consulting architect is A. Gordon Lorimer. The writer is Project Engineer on the job. W. W. Mack, formerly Chief Engineer of the Delaware Highway Department, is serving as director of the project for the state.

Long Beach Shipyard Endangered by Subsidence

(*Continued from page 47*)

elevation of, and connected with the platform of, the quaywall structure. Sufficient raised area will be provided around the caisson for the handling of ship lines. The future program also calls for a wall of varying height around each drydock to prevent overtopping at high tide when the dock is flooded. For Drydock No. 1, this wall varies in height from 3 ft at the outboard end to $5\frac{1}{2}$ ft at the head.

The first year's program for remedial construction will cost approximately $1,500,000. The complete program, spread over a five-year period, will total $4,500,000. Funds for the first year have recently been made available, and work will start in the near future.

Sewage, fortunately, is handled by a pressure system which has not been affected by subsidence. Storm mains however, in addition to settling, have lost their pitch because of differential rates of settlement along their length. Eventually it may be necessary to reverse the flow in these mains and to collect and pump water overboard from what was formerly the high end of the pipe system.

Subsidence at Long Beach has presented many unusual and difficult problems, involving legal as well as technical difficulties. Studies to date show that the major portion of the subsidence is caused by the compaction of the oil zones incident to the removal of oil and gas. No proved methods of stopping or checking subsidence exist, but it is believed that reduction in the rate of removal of oil in conjunction with flooding of the oil zones may prove very beneficial.

Protection adequate to the shipyard's needs for the next 15 years—perhaps much longer—can be provided at a cost of about $4,500,000, and work on the first increment will start soon. However, the building of dikes is not the answer to the subsidence problem. Only when means are found to stop sinkage of the ground itself can the civil engineer, the geologist, and the petroleum engineer consider their work completed.

New Publications

Highway Research. The first postwar report of the Road Research Board of the British Department of Scientific and Industrial Research includes studies of traffic flow, headlight glare, and accident records. Recent researches on materials and methods of construction, according to the report, place increasing emphasis on the use of machinery and on detailed soil studies as an integral part of road construction. The report sells for 55 cents, upon application to the Department of Scientific and Industrial Research, 4–12 Regent Street, London S.W.1.

Gas Transportation. Engineering problems involved in the design or operation of systems for the transportation of gaseous fuels and in the flow of gas in pipes are treated in a 226-page photo-offset volume, *Gas Transportation System Calculations*, by Benjamin Miller. Inquiries should be addressed to the Moore Publishing Co., Inc., 9 East 38th Street, New York 16, N.Y. The volume sells for $7.50.

Construction, New York City. Public works construction progress made in New York City in the past three years is outlined by the Office of the City Construction Coordinator in a recent report to the mayor entitled *N.Y.C. Construction, 1946–1949*. To date plans for $1,150,000,000 of construction have been completed and plans for $1,800,000,000 of work are under way. The program includes major improvements in the field of sewage treatment, garbage disposal, hospitals and health, public buildings and bridges, transportation, pier construction, housing, civic centers, and park development and expansion. Copies of the report may be obtained from the Office of the City Construction Coordinator.

Engineering Data. Sources of engineering information, compiled by Blanche H. Dalton, librarian of the Engineering Library at the University of California, has just been reprinted by the University of California Press, Berkeley, Calif. This concise reference work enables the engineer to find the key to all previously published research in a field by turning directly to the topic. It may be purchased from the university press at $4 a copy.

Airport Planning. Recommendations for construction of 22 new airports in the San Francisco Bay area by 1960 and the consolidation, relocation, or replacement of some existing facilities to avoid the problem of overlapping airspace above fields in close proximity are made in a recent 123-page *Airport Plan for the San Francisco Bay Area*. The plan was prepared for the San Francisco Bay Area Council by the Bay Area Airport Planning Group assisted by the City Planning Commission, the Department of City and Regional Planning of the University of California, and the Department of Public Utilities. The Airport Plan is available at the offices of the Council, 315 Montgomery Street, San Francisco, Calif., at $1 a copy.

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Wood Preservation. Use of treated fence posts in Virginia is advocated as an economy measure by a recent Department of Agriculture bulletin, entitled *The Preservative Treatment of Virginia Fence Posts*, which has just been released by the Division of Planning and Economic Development at Richmond, Va. The authors of the 26-page bulletin—R. A. Hertzler, Assoc. M. ASCE, and Walton R. Smith, of the Southeastern Forest Experiment Station, U.S. Forest Service, Asheville, N.C.—point out that Virginia farmers could save much time and money annually by replacing the nine million posts needed each year with treated, rot-resistant posts. Full details of treatment are given. Copies of the bulletin are available at the Richmond or Asheville addresses.

Groundwater Supplies. Availability of additional groundwater for irrigation and other uses in Paradise Valley, Humboldt County, Nevada, is announced in a joint report of the water resources of the area made by the State Engineer of Nevada and the U.S. Geological Survey. Copies of the report, which is issued by the State Engineer of Nevada as Bulletin 10 in a series on the groundwater resources of the state, may be obtained from the offices of the State Engineer in Carson City, or the Geological Survey, Ormsby County Court House, Carson City.

Economic Surveys. To provide a guide to current business and economic research projects being carried on by bureaus of business research and in American colleges and universities, the Department of Commerce has issued a *Survey of University Business and Economic Research Projects, 1947–1948*. The publication may be purchased from the Superintendent of Documents, Washington 25, D.C., or from any Department of Commerce field office for $1 a copy.

Aerial Photography. The status of aerial photography in the United States is depicted on an index map, recently made available by the Map Information Office of the U.S. Geological Survey. Persons desiring to obtain aerial photographs for a given area may determine from the status map whether photography is available and also the agency that holds the film. The present map is the fourth edition of a series, which is intended to present a periodic inventory of areas that have been photographed or are about to be photographed. Inquiries should be addressed to the Map Information Office of the Geological Survey, Washington 25, D.C.

Steel Making. The manufacture of steel in the United States from the raw-materials stage through the finished product is graphically described in a recent publication of the United States Steel Corp., entitled *Steel Making in America*. Prepared primarily for students, the 100-page illustrated publication will be of interest to others wanting a simple presentation of the facts. Inquiries regarding it should be addressed to J. Carlisle MacDonald, Assistant to Chairman, United States Steel Corp., 71 Broadway, New York 6, N.Y.

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(*Continued from page 93*)

Dam Construction. Planning, design, construction, and initial operation of the Watts Bar Project on the Tennessee River are detailed by the Tennessee Valley Authority in its recently issued Technical Report No. 9. The 545-page illustrated report emphasizes the importance of the project in the over-all system operations. The appendixes include a complete statistical summary of the physical features of the project; reports of the engineering and geologic consultants; summaries of special studies; and lists of major purchases and construction equipment. Bibliographies of each phase of the project are also included. The report may be purchased from the Treasurer's Office of the TVA, Knoxville, Tenn., for $2.

Highway Research. Many new relationships between pavement variables are developed in the 1948 Supplement to Research Report 4-B of the Highway Research Board, which consists of a final report on Norman W. McLeod's work on Airport Runway Evaluation in Canada. The report includes much information of value to highway design, materials, and soils engineers, as well as material on airport runways. Discussions by W. K. Boyd and C. R. Foster, of the Waterways Experiment Station, are included, with a closure by Dr. McLeod. This supplement was originally given at the 27th annual meeting of the Highway Research Board, and inquiries concerning it should be addressed to the Board, 2101 Constitution Avenue, Washington 25, D.C.

Construction, Safety. The safe way of performing construction work and the costly results of incorrect, unsafe practices are stressed in the third revised edition of *The Manual of Accident Prevention in Construction*, published by the Associated General Contractors of America. The current 264-page illustrated edition of the manual, which was first published in 1927, was revised under the direction of the AGC Accident Prevention Committee. Inquiries concerning the publication, which sells for $3, should be addressed to the AGC, Munsey Building, Washington 4, D.C.

Welded Steel. Design and construction of welded steel penstocks are discussed in Engineering Monograph No. 3 recently issued by the Bureau of Reclamation. Adapted from a paper by P. J. Bier, mechanical engineer for the Bureau, which was presented at the 1949 Annual Meeting of the ASCE, the study is based on Bureau of Reclamation experience in penstock construction during the past 20 years. Copies may be obtained from either the Denver, Colo., or Washington offices of the Bureau, at 25 cents each.

University of Illinois Research. A wide range of engineering experimentation conducted at the University of Illinois during the past year is reported in Engineering Experiment Station bulletins recently received at Society Headquarters. These include Bulletin Series No. 380, *Fatigue Strength of Fillet-Weld, Plug-Weld, and Slot-Weld Joints Connecting Steel Structural Members*, by Wilbur M. Wilson, M. ASCE, William H. Munse, Jun. ASCE, and Walter H. Bruckner, conducted by the Station under the supervision of the Committee on Fatigue Testing (Structural) of the Welding Research Council, 60 cents; Series No. 38, *An Investigation of the Backwater Profile for Steady Flow in Prismatic Channels*, by Wallace M. Lansford and William D. Mitchell, Members ASCE, conducted in cooperation with the U.S. Geological Survey, 50 cents; Series No. 42, *First Progress Report of Laboratory Investigation of Roadbed Stabilization*, by Ralph B. Peck, Assoc. M. ASCE, conducted in cooperation with the Association of American Railroads, 10 cents; and Series No. 43, *Progress Reports of Investigation of Railroad Rails, Joint Bars and Manganese Steel Casting*, by R. E. Cramer and R. S. Jensen, conducted in cooperation with the Association of American Railroads and the American Iron and Steel Institute, 15 cents. For copies of these publications address the Engineering Experiment Station, University of Illinois, Urbana, Ill.

Hydraulics. Results of hydraulic investigations recently completed at the Waterways Experiment Station are detailed in two publications announced by the Army Corps of Engineers. These are Technical Memorandum No. 2-294, which reports a study of "Conduits and Howell-Bunger Valves, Narrows Dam, Little Missouri River, Arkansas," and Technical Memorandum No. 2-291, describing hydraulic model investigation of wave action at a breakwater location at Oswego Harbor, New York. Both memoranda may be purchased from the Waterways Experiment Station, Vicksburg, Miss., at $1 each.

Recent BOOKS

ADVANCED CALCULUS FOR ENGINEERS. By F. B. Hildebrand. Prentice-Hall, New York, 1949. 504 pp., diagrs., tables, 8½ × 5½ in., cloth., $8. This book is an integrated presentation of special topics and useful methods of calculus found to be essential to engineers and physicists. The first five chapters are concerned with ordinary differential equations; succeeding chapters deal with ideas and tools of vector analysis, introduce and apply the basic concepts of partial differential equations, and discuss the theory of a complex variable. Problems with answers are included.

ELEMENTS OF STRENGTH OF MATERIALS. 3 ed. By S. Timoshenko and G. H. MacCullough. D. Van Nostrand Co., New York, Toronto, London, 1949. 426 pp., illus., diagrs., charts, tables, 9¼ × 6 in., leather, $5. Based on the author's work of the same title published in 1930, this book is considerably abridged and is designed for undergraduate courses in elementary strength of materials. It covers stresses and strains, moments and deflections, and methods for testing the mechanical properties of materials. New problems are included, with partial or complete answers; standard symbols and abbreviations are used; and some topics have been added, such as plane strain, the use of strain rosettes, etc.

HISTORY OF THE DEVELOPMENT OF BUILDING CONSTRUCTION IN CHICAGO. By F. A. Randall, M. ASCE. University of Illinois Press, Urbana, Ill., 1949. 388 pp., illus., tables, 10½ × 7 in., cloth, $5. This book is a detailed history of the structures, the foundation engineering and construction methods of the buildings in the "Central Business District" of Chicago. Since all buildings could not be described minutely, liberal reference is made to other sources of description and illustration. A chronological arrangement is used.

HYDROLOGY. (Physics of the Earth—IX.) Edited by O. E. Meinzer and others. Dover Publications, New York, 1949. 712 pp., illus., diagrs., charts, maps, tables, 9½ × 6 in., cloth, $4.95. This reprint of Volume IX of the "Physics of the Earth" series is of practical value to agronomists, engineers, physicists, and geologists as it covers the whole hydrologic cycle in considerable detail. The several chapters and sections were contributed by authorities on the specific topics.

HYDROLOGY. By C. O. Wisler, M. ASCE, and E. F. Brater, Assoc. M. ASCE. John Wiley & Sons, New York; Chapman & Hall, London, 1949. 419 pp., illus., diagrs., charts, maps, tables, 8¼ × 5¾ in., cloth, $6. Intended for use as a college text, this book presents fundamental principles. The main topic covered is stream flow, its fluctuations and the causes thereof. The distribution graph, the unit hydrograph, and the theory of infiltration capacity are included. References are given as footnotes, and there are many diagrams and charts.

LABORATORY MANUAL IN SOIL MECHANICS. By R. F. Dawson, M. ASCE. Pitman Publishing Corp., New York and London, 1949. 177 pp., diagrs., charts, tables, 11 × 8½ in., paper, $3.25. An elaboration of original notes for laboratory use, this manual presents detailed procedures for some 20 important tests and analyses. Basic considerations such as the taking and preparing of samples precede the more specific test methods. All tests conform to the standard methods prescribed by recognized bodies such as the American Society for Testing Materials and the American Association of State Highway Officials. Data sheets are provided for recording test values.

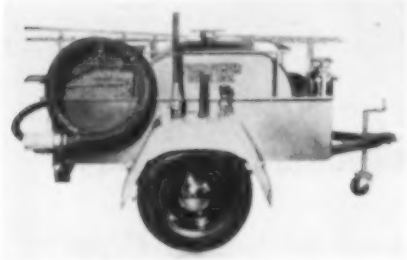
MATERIALS OF CONSTRUCTION, WOOD, PLASTICS, FABRICS. By A. G. H. Dietz, Assoc. M. ASCE. D. Van Nostrand Co., Toronto, New York, London, 1949. 347 pp., illus., diagrs., charts, maps, tables, 9¼ × 6¼ in., linen, $4.50. In this book stress is given to the essential nature of the materials discussed and to the development of their applications from those basic attributes. The properties and uses of wood, plastics, and fabrics are discussed separately as well as in circumstances where they are used in combinations. Composite materials are treated in the final chapter. Selected bibliographies follow each chapter.

EQUIPMENT, MATERIALS *and Methods*

NEW DEVELOPMENTS OF INTEREST, AS REPORTED BY MANUFACTURERS

Fire Fighting Trailer

A PORTO-PUMPER FIRE fighting trailer has been announced. The trailer is equipped with a demountable Porto Pump, which is a rotary positive displacement type rubber gear pump, powered by a 4 cycle gasoline engine; supply hose; aluminum extension ladder; 200′ of fire hose; fire axe and hand extinguisher; straight stream nozzle; combination fog and straight stream nozzle—plus the added feature of a 200 gal water tank.



Trailer Features Demountable Pump

It pumps water from any source—hydrant, well, ditch, pond, stream—rapidly and efficiently. Other new equipment offered as optional with the trailer includes the latest type nozzles for foam producing, making this unit ideal for protecting oil and gas storage depots, lumbering concerns, the forestries, small towns and villages, resorts, industrial plants, food storage and produce elevators, airports and all other isolated enterprises, etc. This unit can be attached to any vehicle. Extensive training is not necessary—it's easy to operate. Its size, only 6′ × 9′ eliminates expensive housing. Further information is available from **Porto-Pump, Inc., 227 Iron St., Detroit 7, Mich.**

New Line of Chain Saws

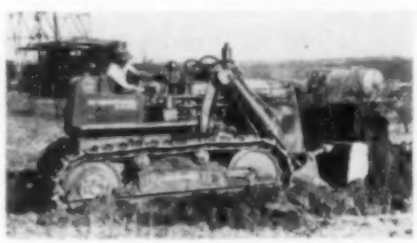
THE ADDITION OF SIX new models to the Mall chain saw line plus the improvement of four other models has just been announced. One and two-man models of timber chain saws are now available with gasoline engine, electric and pneumatic power units. Featured as the big 10 in the chain saw field, all models are designed for quick and efficient cutting for contractors, builders, engineers, railroads, arborists and many others. The feature of the new line is the hand electric chain saw designed for one hand use. Priced under $100.00 this saw will operate from regular household current and can be used with an extension pole for tree trimming and pruning from the ground. Write for additional information and prices for all models. **Mall Tool Co., 7725 S. Chicago Ave., Chicago 19, Ill.**

Gravimetric Chlorinizer

A LINE OF VOLUMETRIC chlorinizers have been supplemented with a gravimetric chlorinizer, Model CGS, which establishes new standards of accuracy in feeding chlorine gas to produce chlorine water solutions. The new unit meters and feeds gaseous chlorine by the precise and dependable loss-in-weight principle. While particularly suited to very high capacities, Model CGS is equally well adapted to exact low rate feeding. The chlorine control cabinet and chlorine weight scale are separate units, inter-connected only by small air piping. No chlorine is present at the control station. Many unique features assure safe operation, accurate control, and long life. For further information and bulletins, address the manufacturer. **Builders-Providence, Inc., Providence 1, R. I.**

Diesel Crawlers

MORE POWERFUL, "A" models of the International TD-18 and TD-14 diesel crawler tractors, are announced. Both, now in production, have greater work capacities than previous models, and incorporate a number of new features designed for increased operator comfort and longer trouble-free service life. The heavy-duty TD-18A, second largest in International's line of diesel crawlers, has 87 drawbar hp. Net engine hp at the flywheel is 107. Belt hp has been raised to 101. In the TD-14A, third largest of the crawler line, hp has been increased to 76 at the engine flywheel; 60.5 drawbar, and 72 belt. This tractor has higher



Model TD-14

maximum drawbar pull of 16,600 lb in first gear. Both tractors feature spring boosters on the steering clutch hand levers for greater ease of operation; a closed cooling system which prevents loss of coolant when the tractor is working on a steep grade, and increased efficiency lubricating oil filters. The new-type lubricating oil filters have increased filtering area and require changing only every 240 hr of operation under normal conditions, compared to the previous 100 hr change period. Specification sheets and catalogs are available upon request. **Consumer Relations Dept., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.**

Transit Crane

TO MEET THE NEEDS of contractors requiring a heavy-duty crane-excavator mounted on rubber, Bucyrus-Erie announces production of the 22-B transit crane. High speed job-to-job mobility and a sturdy working base are assured in the newly designed transit crane wheel mounting. The 142 hp mounting is built by Sterling for exclusive use with the 22-B transit crane. Durable frame is of alloy welded steel construction with bumper and outrigger brackets welded

Model 22-B

integral. Two double box outriggers provide additional support on the job. Full vision truck cab, air brakes, Timken-Detroit axles, optional hydraulic booster steering, and 12-speed transmission are other features of the wheel mounting. A new crane type boom, for lifting crane, clamshell and dragline operation, has been specially designed to combine strength and length. Removable inserts may be used to increase the standard 30′ boom to an 80′ boom in lifting crane service. For traveling, long booms are quickly folded with special equipment. A full range of front end equipment is available. The crane may be converted in the field for shovel, dragline, dragshovel, clamshell or crane operation. **Bucyrus-Erie Co., South Milwaukee, Wis.**

Structural Calculator

A CALCULATOR FOR use in designing structural steel, known as the structural calculator, is composed to save computing time with problems of stress analysis. The calculator is ideal for engineers, architects and students who wish to have all the information on stress analysis at their fingertips. It measures 8 × 10½ in. and is easily slipped in a brief case for field use in checking stresses of beams and columns. It is finished with a protective coating which prevents soiling. An instruction manual with illustrative examples is furnished with each calculator purchased. **Calculator Design Service, Inc., 101 Park Ave., New York 17, N. Y.**

Equipment, Materials & Methods (Continued)

Motor Grader

THE NO. 303 HAS been produced to fulfill the need for a rugged, medium-duty grader at the lowest possible price consistent with traditional Galion quality and dependability. The motor grader can be supplied with either a gasoline or diesel engine—both 45 hp at 1600 rpm. Another budget-fitting feature is offered in a choice between an all-gear four-wheel tandem drive or single drive. Eight overlapping forward and two reverse speeds are said to assure maximum performance under all operating conditions. All operations of

Model 303

the blade, scarifier, and leaning front wheels are completely hydraulic. Adjustments are instantly and accurately made by finger-tip touch on the control levers. Blade is adjustable 360° horizontally for operation in reverse, and 90° vertically for bank cutting. Standard equipment includes an electric starter. For complete information, write **The Galion Iron Works & Mfg. Co., Galion, Ohio.**

Pneumatic Concrete Placers

PRODUCTION OF PNEUMATIC concrete placers is again under way at Worthington, after being suspended during the war years and the years immediately following. The Worthington-Ransome pneumatic concrete placer is designed to place concrete in subways, tunnels, isolated bridge piers, and wherever accessibility makes the ordinary methods impractical or too expensive. The 14 cu ft machine requires only 400 cu ft of air for 100′ shots at the rate of 60 per hr. For full information write for Bulletin R-105C. **Worthington Pump & Machinery Corp., Harrison, N.J.**

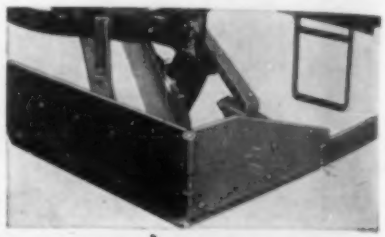
Paving Breaker

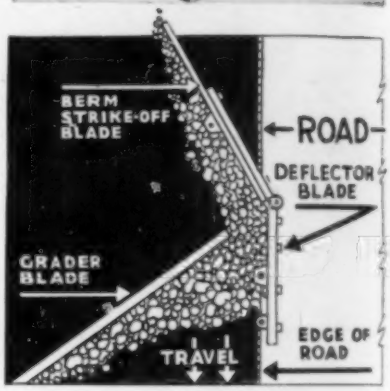
AN ADDITION TO THE Cleco Division is the RC-80 paving breaker. This tool incorporates the Reed-Cleco rock drill type valve which gives full control of both power and reserve stroke, assuring hard, uniform blows, fast action, minimum recoil, easy "riding" qualities and low air consumption. The reversible grooved piston is cushioned on the power and return stroke, reducing operator fatigue and eliminating side rod breakage. An air reservoir in the back head assures uniform air pressure to the piston. For further information ask for Bulletin No. RC-949. **Cleco Div., Reed Roller Bit Co., P. O. Box 2119, Houston 1, Tex.**

Equipment, Materials & Methods (Continued)

Berm Shaper

RUTS, WASHOUTS, AND HOLES, where berms and edge of pavement meet, have always been a universal and troublesome maintenance problem. The berm shaper attachment has been designed to fill these worn and dangerous spots and reshape the berm flush with the surface of the pavement—in one operation. The attachment consists of a deflector plate, a distributing or strike-off blade and connecting parts. It is attached to and works in conjunction with the motor grader moldboard and circle. The concentration of excess material in the corner of the deflector is said to assure a complete filling and reforming of the berm against the edge of the pavement. The angle of the strike-off blade, and the hinged section of the deflector plate to which it is attached, is adjustable to suit varying materials and operating conditions. The berm shaper is designed for use with the Galion No. 402 maintenance grader. For complete information write **The Galion Iron Works & Mfg. Co., Galion, Ohio.**





Fills and Reshapes in One Operation

Hi-Way Widener

PRODUCTION IS WELL under way on the newly designed Hi-way Widening machines. On the job, the Buckeye Model 616 hi-way widener cuts side ditch to grade in one pass without disturbing the base. A clean ditch is left ready for the paving material. Powered by a GM 67 hp diesel engine in conjunction with a fluid coupling the hi-way widener digs up to a mile a day of side ditch depending on soil conditions. The operator sits on a comfortable swivel seat with a complete

(*Continued on page 99*)

Equipment, Materials & Methods (Continued)

view of the digging wheel, highway edge and passing traffic. Heavy-duty digging wheel will dig up to 18 in. deep with cutting widths of 24", 30", 36", 42" and 48". Reversible conveyor deposits spoil on either side of the machine as desired. After digging operations are completed the hi-way widener can move from job to job at speeds up to 20 mph. Ask for Bulletin 616. **Gar Wood Industries, Inc., Findlay Div., Findlay, Ohio.**

Skipper Mixer

MANY EXCLUSIVE FEATURES make the Rex 3½ S skipper mixer tops in its field; pivoted hopper; stationary charging gate, this feature allows loading the hopper while another batch is in the drum, non-clogging, it is mounted above the center line of the drum, free from the spatter of mixing concrete; water system; chain drum drive; discharge chute and towing. Easy

Rex Model 3½

operating, grouped controls add to the efficiency of this mixer. Skip lever acts as skip shaker arm to get the batch into the drum fast. Concrete cannot build up in the skip throat. Bulletin #49-16 lists specifications and illustrations. **Chain Belt Co., 1600 W. Bruce St., Milwaukee 4, Wis.**

Trenching Machine

ENGINEERED TO FIT the new, present-day needs of contractors, utilities and municipalities, a small, compact model of the famous Cleveland "Baby Digger" trenching machine has been placed on the market. Known as the Baby Digger Model "92", it is especially adapted for gas, water and sewer house services, for telephone and power cable and conduits, for house and building footings and for airport, highway and farm drainage and irrigation. Chief advantages of the "92" are its small compact modern size—allowing easy maneuvering in tight places and quick moves from job to job on its own rubber-tired tilt-bed electric-braked trailer —and its ditch capacities. Other features

(Continued on page 100)

Equipment, Materials & Methods (Continued)

are: absolutely clog-proof crawler tracks, operator-controlled power-shift conveyor giving instant control of the spoil bank; patented "Presto-Points" for quick and easy replacement of rooter teeth; and a crumbing shoe giving perfect grading and clean trench bottom, and which can be swung up and away to permit digging right up to foundations, walls and trees. Write for Bulletin S-53. **The Cleveland Trencher Co., 20100 St. Clair Ave., Cleveland 17, Ohio.**

Circulator Pump

DESIGNED PRIMARILY for modern forced circulation and radiant heating systems, this circulator pump is proving to be ideal for many other applications. The non-clogging feature makes it desirable for recirculation and transfer applications in dairies, food processing and chemical plants, breweries, mines, etc. Also used as

Multiple Purpose Pump

a coolant pump for evaporative coolers, machine tools and production processes. For operating totally submerged or in damp and wet locations, the circulator can be furnished with an Enpo submersible motor. Other features include capacity of more than 40 gpm at 10 ft head; high efficiency and power factor; armored motor; accessibility without removing plumbing. Available in all standard voltages and frequencies. Free literature available on request. **Piqua Machine & Mfg. Co., Piqua, Ohio.**

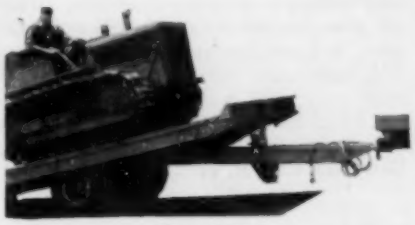
Drafters

IMPROVED AND REDESIGNED models of the well-known Bruning drafters have recently been announced. These models introduce the exclusive Bruning "Equipoise" mechanism, a device that counteracts the effect of gravity, when the draftsman is working on a tilted drawing board. Drafters combine all the functions of T-square, straightedge, triangles, protractors, and scales into a single precision machine. The drafter cannot drift down the board. Neither is there any tendency to kick back. The drafter glides into any desired position—and holds that position. The draftsman can align the drafter scales quickly and accurately to any part of his drawing. Among the many new features are a redesigned base line clamp, ball joints on both arms, increased space between the double thumb screws and the Equipoise mechanism. A 20-page, highly illustrated booklet has just been published describing all models of the drafter, as well as containing detailed drawings of 38 standard and special scales available for use with the drafter. Requests should be made for Bulletin A-1055. **Charles Bruning Co., Inc., 4754 Montrose Ave., Chicago 41, Ill.**

Equipment, Materials & Methods (Continued)

Tilt Deck Trailer

A NEW TILT DECK trailer has just been announced. It carries four 8.25″ × 15″—14 ply tires and has a capacity of 7 tons. The road clearance is 16 in. The deck is 16′ × 8′ and 34 in. high. Air or vacuum brakes are optional. An interesting feature is the double acting hydraulic ram which cushions the deck when being raised or lowered. A 5-ton trailer is also available, equipped with 7.50″ × 15″—10 ply tires. **Rogers Brothers Corp., Albion, Pa.**



7-Ton Trailer

Overshot Loader

The Austin overshot loader can be attached to any late model crawler type tractor. The tractor operator operates the bucket with one lever which permits him to stop it in any position, instantly. It combines a straight-in-line mucking with larger capacity. Horizontal mounting of the main bucket arm permits the operator to doze his load with full power of the tractor. Chain drives lead from the power take-off to one of two hubs upon which a steel web wraps and unwraps—creating a variable speed operation which exerts maximum power at the loading phase and gradually increasing bucket speeds until the load is dumped. Operation is 100% mechanical. Three sizes are offered, according to the manufacturer's literature, for $1\frac{1}{2}$ cu yd rated capacity bucket $2\frac{1}{2}$ and 4 cu yd. It has proved its efficiency in all sorts of stockpiling, sand, gravel, and quarrying, large scale snow removal and handling coal. **John Austin, Inc., Longmont, Colo.**

Operation is 100% Mechanical

Literature Available

WELDING SUPPLIES—An 8-page booklet offers descriptive information on welding supplies. Electrode holders, protective shields, welding cable and other equipment included with charts and diagrams. **Lincoln Electric Co., Cleveland 1, Ohio**

GROUTING METHODS—A 4-page booklet gives detailed information on Presscrete and pressure grouting methods. This machine can be used for structural repairs, soil stabilization, groundwater control, foundation piles, pile encasing, railroad work, and mine safety work. Pictures and illustrations are included. **The Presscrete Co., Inc., 243 Graybar Bldg., New York City, N. Y.**

WATER PRE-TREATMENT—A new 8-page, 2-color leaflet entitled "Dorr Equipment and Methods for Modern Water Pre-Treatment" has been released. It contains brief descriptions and photographs of all Dorr equipment available for water pre-treatment in the municipal and industrial fields. Also included are flow diagrams and a convenient table of basic design data for plant units treating various types of water. **The Dorr Co., 570 Lexington Ave., New York 22, N.Y.**

PILING EQUIPMENT—A 120-page catalog on pile hammers, pile extractors, and complete pile driving rigs has just been prepared. More than 140 illustrations show various hammers and extractors in use handling concrete, steel, and wooden piles in the construction of bridges, dams, building foundations, highways, railroads, piers, and many other projects all over the world. Complete specifications, dimensions, part lists, operating and maintenance instructions are included. **McKiernan-Terry Corp., Dept. C, 15 Park Row, New York 7, N.Y.**

HYDRO DRILL JIB—A new bulletin on "Joy Hydro Drill Jibs" has been released. The hydro drill jib is a mounting to carry standard rock drills on either regular drill feeds or on long chain feeds. Illustrated and described in the bulletin are hydro-drill jibs mounted on trucks or on tunnel jumbos. An interesting application described in the bulletin, in addition to that of tunneling and cut-and-fill work, is a labor and time-saving arrangement to drill holes for highway mud-jacking or sub-sealing. **Joy Mfg. Co., Henry W. Oliver Bldg., Pittsburgh 22, Pa.**

RECORDING THERMOMETER—A bulletin on the traveling-oven recording thermometer has just been published. The bulletin describes the use of the instrument with various types of conveyor ovens to record finishing, lacquering, japanning, drying and baking temperatures. Illustrated with photographs and reproductions of typical chart records, the new bulletin, No. T842, also contains complete specifications and prices. **The Bristol Co., Waterbury 91, Conn.**

Literature Available (Continued)

CONCRETE PIPE—A 12-page, 2-color booklet on the use of concrete pipe "Then & Now," covering a span of 107 years, has been produced. Reproduction of early booklets, invoices, price lists, tests, advertisements and testimonials, highlight the historical résumé. The text closes with three testimonial letters written in 1866 and 1869 by city officials, engineers and water works superintendents. **Universal Concrete Pipe Co., Columbus, Ohio.**

CAVITATION & PITTING—"Prevention and Reduction of Cavitation and Pitting in Hydraulic Turbines" is the subject of a 12-page bulletin. Applicable basic formulas are elaborated upon and the relative merits of avoiding cavitation or minimizing its effects are presented. Pitting is differentiated from erosion and corrosion. The mechanisms of cavitation and pitting are explained in light of recent evidence. Copies of the bulletin, 02B7226, are available upon request. **Allis-Chalmers Mfg. Co., Milwaukee, Wis.**

WAGON DRILLS—A 12-page book is devoted to three sizes of wagon drills, light weight, medium weight, and heavy weight. One interesting feature is a series of line drawings which show how drilling costs are reduced with these highly mobile wagon mountings. These illustrations indicate initial equipment savings as well as savings in operating costs. The book is well illustrated with photographs of various field applications. **Joy Mfg. Co., Henry W. Oliver Bldg., Pittsburgh 22, Pa.**

CUTTING CONCRETE COSTS—"Seven New Ways to Mix and Place Concrete at Lower Cost," is the title of a new 8-page Dumpcrete folder which shows an action picture of each job, a view of the plant, and a listing of equipment that goes to make up the plant. Also included is a brief description of the job and the name and address of contractor. Your copy of this folder, L-107 will be mailed by sending your request to **Dumpcrete Div., Maxon Construction Co., Inc., 131 N. Ludlow St., Dayton 2, Ohio.**

SCREEN CLOTH—A bulletin titled "Robins Woven Wire Screen Cloth," No. 113-A, has just been issued. Of its 16 pages, many are devoted to tables enabling the reader to determine at a glance the sizes of openings available for a given diameter of wire. Also included are recommendations regarding the best wire-diameter to select for a specific type of service—processing sand, stone, coal, coke and other granular materials. **Robins Conveyors Div., Hewitt-Robins Inc., 270 Passaic Ave., Passaic, N.J.**

SAND & CEMENT HOSE—Describing the construction by cut-away illustrations and text, a new catalog section on Goodrich's sand and cement hose is now available upon request. Three lines are included, sand discharge and placement hose, cement handling hose and grout hose, and specifications and data given in tables for each. **The B. F. Goodrich Co., Akron, Ohio.**

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